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FOR QUARTER CENTURY
THE BRICKBUILDER

OCTOBER 1917
VOLUME XXVII ~ NUMBER 4

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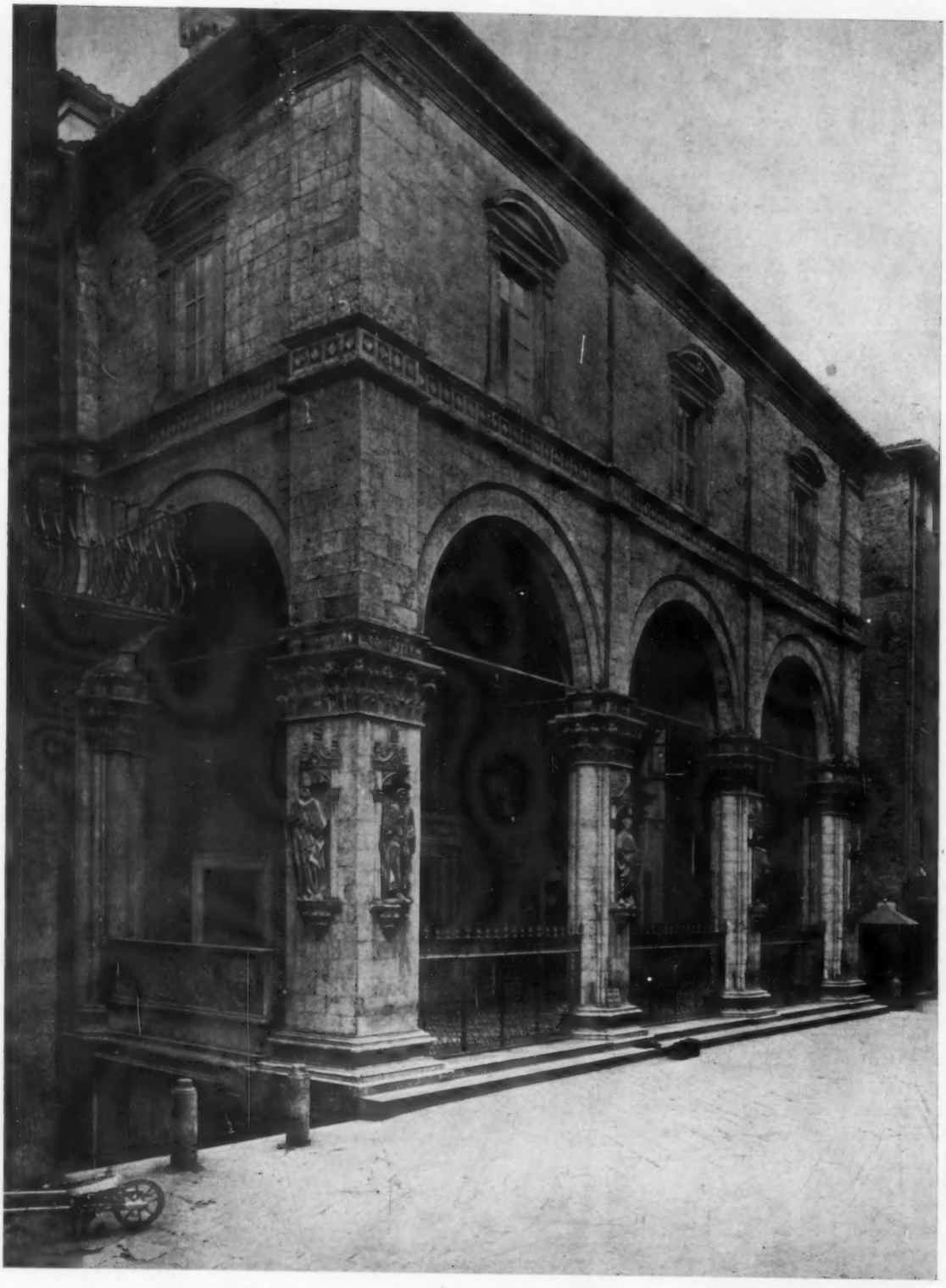

LOGGIA DEI MERCANTI, SIENA, ITALY

DESIGNED BY SANO DI MATTEO

THE ARCHITECTURAL FORUM
FOR QUARTER CENTURY THE BRICKBUILDER
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Recent Hospitals for the Navy

By F. W. SOUTHWORTH
Architect, Bureau Yards and Docks, Navy Department

NAVAL hospitals have been built recently for the Bureau of Medicine and Surgery, Navy Department, at Chelsea, Mass., Portsmouth, N. H., and Newport, R. I. The plans and specifications were prepared by the Bureau of Yards and Docks and the construction was under its supervision also. The buildings at the three stations are practically identical and typify the latest development in Naval Hospital construction. The demands of naval and civil hospitals differ little except, perhaps, in administration, and in accommodation of patients. In naval hospitals less space is required for executive, emergency and dispensary work and fewer private rooms and suites are needed. The buildings were designed with especial attention to economy of service both for the present needs and for possible future extension. The complete layout provides for four additional ward buildings without change in administration or subsistence buildings. Each ward is designed for a normal capacity of thirty beds, the number of patients found by Navy experience to be the most economically cared for in one room. The number of beds in a ward can be increased by fifty per cent if occasion demands.

The buildings are constructed of brick in nine shades with an interior lining of hollow bricks. Sills and key-stones are of granite, and terra cotta in granite shades is used for belt courses, pilaster caps, and similar trim. Partitions are, in general, 4-inch terra cotta with hard plaster finish. Floors are of reinforced concrete supported by fire-proofed steel construction. The roof covering is slate on wood sheathing carried on steel trusses.

Each hospital group has an administration building, three stories and basement in height, with a two-story and basement ward building on either side. An operating and subsistence building is in the rear of the main buildings and is joined to them by means of corridors and solaria. The buildings are connected on every floor. Each hospital cares for 134 patients normally, but in an emergency would easily accommodate 175 without encroaching upon corridor or solaria space.

Offices for commanding and executive officers are along the front of the first story of the administration building near the first-story wards and elevator, easily supervising the main hospital life. Administrative offices, laboratories, rooms for examination of patients for eye, ear, and throat treatment, and for dispensary work are arranged to facilitate action and avoid unnecessary waiting. The main entrance for patients is through the hall of the administration building but an ambulance entrance is provided in the rear of the administration building opening directly to the elevator. The hospital buildings are provided with ample solarium space, each ward having a large glazed enclosure at its end. Loggias are provided between administration building and wards and the octagonal solarium between the administration building and operating and subsistence building has a partially covered roof garden. The tiled solarium roof is accessible to wheel-chair patients, the elevator running to the solarium roof level. Rooms for hydriatics are located in the basement of one of the wards, with adjacent lounging and rest space.

All kitchen service and supplies go to the rear of the buildings without interfering with patients or visitors entering at the front of the building. The main kitchen is on the ground floor of the operating and subsistence building, and food is carried on wheel trucks to dumbwaiters leading to various diet kitchens on the different floors. Diet kitchens with tile floors are provided with electric stoves. Cleaning gear rooms with tile floors are on each floor of administration building, and in each ward for necessary brooms, mops, etc. Soiled linen is taken from the wards in sterilized canvas bags and dropped through chutes

View of One of the Three New Hospitals for New England (Chelsea, Mass.)

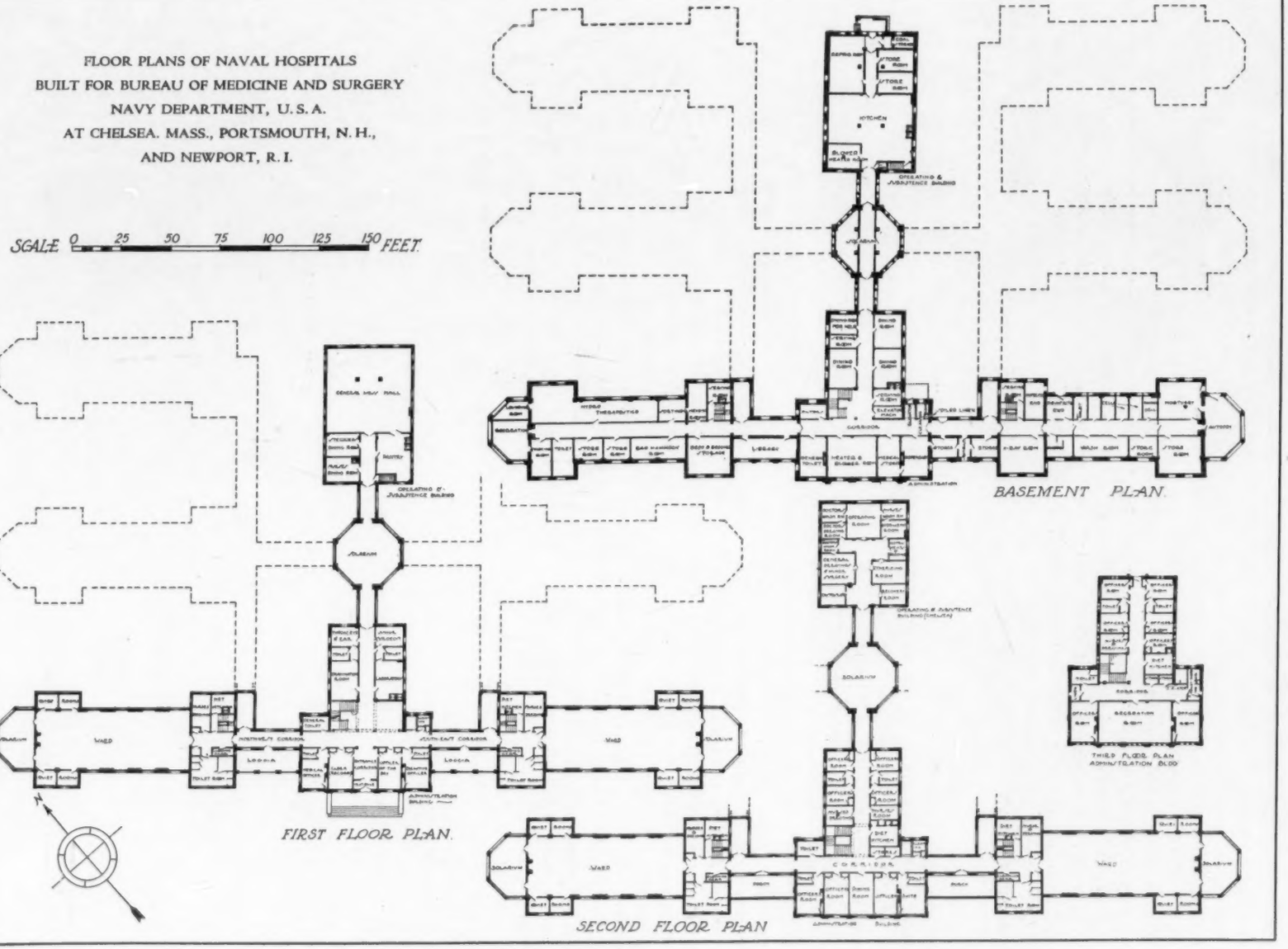
to the basement where an outside door is provided from which the linen is carried directly to the disinfector before going to the laundry. The mortuary and autopsy rooms are located at the extreme end of one of the ward basements with direct outside communication. The photography room has been protected from the X-Ray room, which comes next to it, by means of sheet lead stretched on the wall back of the plaster furring.

Several details of construction have been used in the hospitals that are considered especially good and practicable. Cast iron bases and plinths, 6 inches high, with a 2-inch cove at base flush with floors have been installed throughout the buildings except for the main hall of administration building, and except for tile floors, where wood base and tile base have been used respectively. The cast iron base is secured to the wall by means of clips and is grouted and filled in with cement behind the metal so that the metal base becomes practically integral with the wall. The plaster finish is brought down flush, with the base butting against it. Closet floors are raised 6 inches above room or corridor floors in order that the cast iron base may run across the front of the closets, doing away with cracks and corners at the floor level. This construction also makes it easier to clean and sweep out the closets. Simple window trim has been used without moulds and the section of muntins, rails, and stiles for sashes are without fillets. The feather edge that is unavoidable in the use of a curved section and the omission of the fillets, is taken care of by puttying and varnish. In the actual work the feather edges have come out well and are not impracticable, although the section adds to the expense of the work and is disliked by carpenters on account of the extra care necessary to insure good work.

Except for basements and operating suites, and excepting a few instances in the main hall of the administration building, flush surface wood doors have been used throughout. The doors are a compound, veneered type with birch exposed veneer. The finish is varnish leaving the natural coloring of the wood visible. The trim in general is finished "natural." White painted trim is used only in the operating suite and in toilets and dressing rooms. Basement doors are a stock five paneled pattern. Operating suite doors and all toilet enclosure doors are metal, enameled white, with simple moulds.

The ideal hospital floor is a composition floor, but up to the present time, composition floors at a reasonable price have not proved entirely satisfactory. There are still a few practical points to be overcome, such as cracking, roughness and unevenness of surface, separating from the material on which they are placed, discoloration and decomposition where much water is used. The composition floor would be ideal in that the flooring itself could be carried up 6 inches or more on walls with a coved base. This has been done but has not been successful enough to warrant the chance of ruining large amounts of work. A good floor for wards and patients' rooms is linoleum cemented to a concrete base. Linoleum is easy to walk on, quiet, and clean. Linoleum has been used very successfully abroad where labor conditions are different from the conditions existing in this country. It is extremely difficult, and at times almost impossible, to get labor careful enough to install work of this description. For a successful floor, linoleum should be carefully laid on and cemented to a "builders felt" base approximately one-sixteenth of an inch thick. The felt is laid in cement on the floor. A special cement or glue is prepared for laying linoleum. The felt base not only allows a certain amount of expansion and contraction but also allows the linoleum to be taken up and replaced with little

FLOOR PLANS OF NAVAL HOSPITALS
BUILT FOR BUREAU OF MEDICINE AND SURGERY
NAVY DEPARTMENT, U. S. A.
AT CHELSEA. MASS., PORTSMOUTH, N. H.,
AND NEWPORT, R. I.



effort. Linoleum should be warm when laid to prevent cracking. Linoleum can be carried to a base board with a small scotia or quarter round tacked down on it, or it can be carried up on walls. When linoleum is carried up on walls the edge should be held in place by brass strips secured to the walls and bent to form a ground for plaster, if plaster is used above the linoleum.

Terrazzo has received a great deal of attention and has a great many enthusiastic supporters for flooring use. This is another material that has been more successfully used abroad, especially in German hospitals, than it has been used here. In addition to the cracking to which terrazzo is subject, the terrazzo is noisy and is hard to walk on. Circular ceramic tile has been used for ward floors in certain New York hospitals. The flooring looks attractive at first, but the amount of cement mortar in proportion to the tile is large and has in places worn into dust. It is easily eaten out by acids, and the small tiles break and chip. One advantage of the terrazzo or tile floor is that, if required, the floors can be thoroughly flushed without injuring the flooring material. The floors of the recently constructed naval hospital buildings in North Chicago are of compressed cement tile about six inches square. So far the tiles have given fair satisfaction, but they are expensive, have crazed and have the disadvantage that without constant care they are likely to wear up into a fine dust. After investigating the question of floors very carefully, hard pine, quarter-sawed, heart-stuff flooring was used in the majority of the rooms of the three New England hospitals referred to. The floors, after several waxings, become practically impervious. For kitchens, bath rooms, diet kitchens, and toilets, a hexagonal three-inch vitreous white tile has been used. The vitreous tiles are impervious and when laid properly and evenly with a white cement joint are not only attractive but practicable. The disadvantage in the white vitreous tile is that it needs frequent cleaning even if the tile is properly rubbed down and smoothed off when laid. The operating rooms are floored with Tennessee marble tiles approximately eight by twelve inches in size. Tennessee marble is used on account of its being practically impervious and slow in action under acids. The vitreous tile might have been used in the flooring of the operating rooms but the number of joints are excessive in proportion to the floor area. The tributary rooms in the operating suite are floored with the white vitreous tile, the same as used in baths. Expense prohibited the use of marble tiles in all of the operating suite. Glass floor tiles have been tried in several hospitals for the operating rooms but the glass chips and spalls very easily with any settlement. White marble has been used in a number of civil hospitals for flooring but it is easily acted upon by acids and soon shows wear.

In general, wall surfaces have been plastered. Hard plaster has been used for walls, above basement. All interior angles are coved and all exterior angles are "bullnozed." The walls in wards are painted with a sanitary paint. Tennessee marble wainscot, 7 feet high, with coved base and flush with the plaster has been used in the operating rooms. This was successfully installed with ground joints without mortar. Basement walls are a buff face brick in corridors, kitchen, and rooms other than store rooms.

Hardware throughout the hospital buildings is of a substantial, heavy type, free from ornamentation. It is "solid cast polished bronze natural finish." The hardware will stand constant polishing without changing color or texture, although polishing is not necessary. Window sashes in wards and in rooms occupied by patients are fastened by means of cinch fasts in addition to the ordinary sash fasts on the meeting rails. All doors in operating suites are furnished with dust-proof roses, dust-proof strikes, and keyhole traps. The traps consist of flaps on springs which keep the keyhole closed unless a key is in the lock. That is, the keyhole plate presents a flush surface with no opening apparent when the key is not in use. The same idea is applied to the strikes, keeping the strike as a surface flush with the door jambs when the door is open.

Electrical fixtures throughout the hospital buildings are of the simplest possible design equipped with prismatic extensive or intensive globes, according to the position of the fixture. The canopies are of special design, easily removable and allowing the goose neck or bracket to be kept closely to the wall, considerably closer than most of the commercial fixtures. The operating room lights over tables are in a group of five, so arranged that no shadow is cast on the table. Each light is of 80 candle power and is controlled by a separate switch so there is no difficulty in controlling the amount of light. The shades of the lights over operating tables are spherical and easily cleaned. Dimmer appliances are used where required.

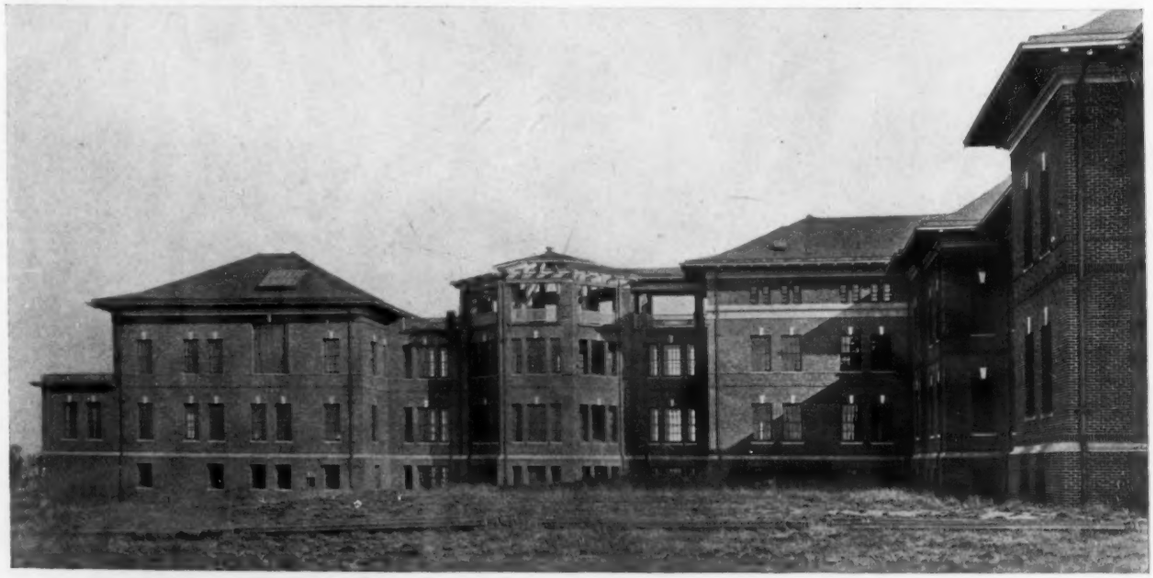
The plumbing layout designed for the hospitals is simple and the fixtures are the best and of the latest design. Where urinals occur, enameled iron tanks have been used with stayed chain pulls.

For water closets, vitreous bowls and low down vitreous tanks have been used. The tanks are large and insure quick and efficient flushing of the bowls. The tanks are covered with simple porcelain lids which are bolted or fastened in place so that they cannot be lifted without the use of proper tools and time. This obviates the probability of the tank lid being raised by any one other than the plumber. The lever arm for flushing the bowl is of such design that it can be readily repaired if injured. Bath Tubs for private use of officers and for use of patients who are convalescent and well enough to take their baths without assistance are of the corner pattern, let into walls and floor so that only two sides of the tub are exposed, and so that there is no chance for the accumulation of dust, dirt, and moisture back of the tub. Where tubs are installed in the general baths of the wards, and where the baths of the patients must be given by the nurses, the tubs are so placed that a nurse can be stationed on either side of the tub. Lavatories and sinks for use in operating suites are equipped with rose sprays, deep bowls, and knee control. Vitreous ware is used in all fixtures where the size will permit. The fittings for all plumbing fixtures, including standards for water closet and bath enclosures, are of "red metal." Red metal is a composition of copper and tin containing not less than 80 per cent of copper and 7 per cent tin. The composition of the red metal is such that it will stand indefinite polishing without change of color. The hardware and plumbing fittings are practically the same in color. Nickel plating looks very well when it is properly cared for and only wiped off as required, but the tendency in most institutions is to polish the metal infrequently and then so severely that the nickel plating soon wears off exposing in places the brass or copper on which the plating is made. Shower baths are provided of simple design and of such construction that the mixing of hot and cold water is simple and so that scalding is possible only through deliberate attempt.

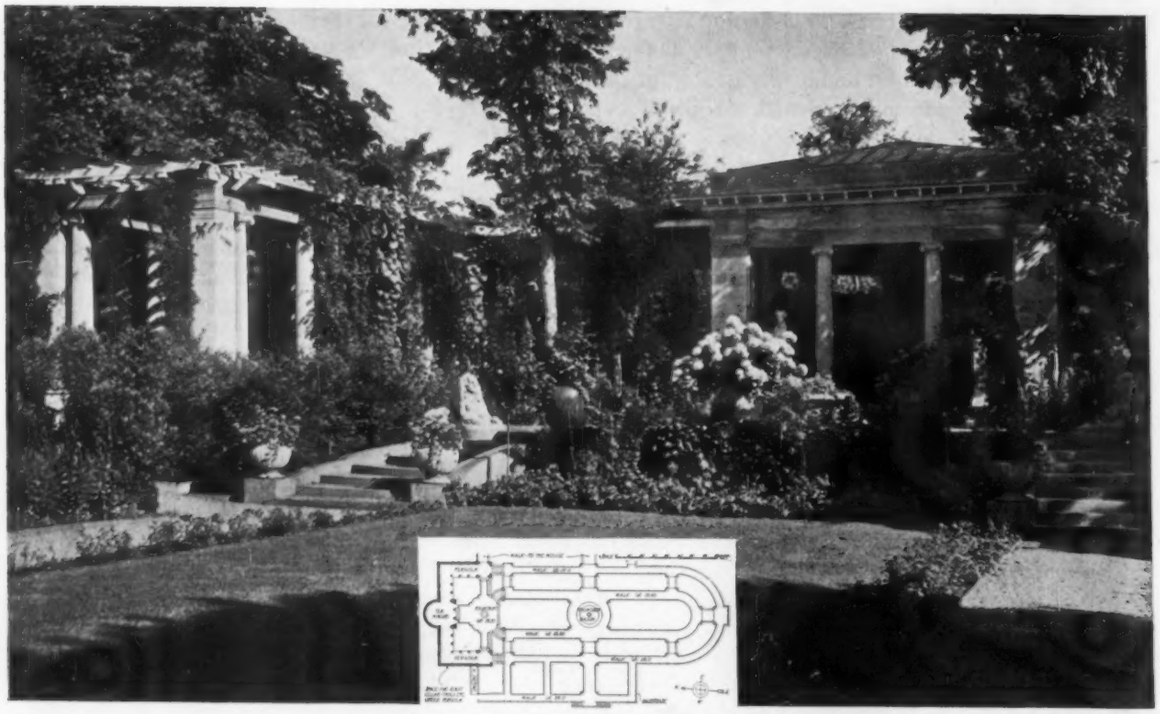
The buildings are heated by plenum and exhaust systems to insure proper ventilation and an even temperature is maintained by the use of direct heat from hot water radiators. For the operating suite the air is washed to prevent dust particles from entering and then re-heated. The air for the operating suite can be maintained at the required degree of heat and humidity.

Radiators for the hot water heating system are of a hospital pattern, free from ornamentation and having sections about three and a half inches on centers. The radiators are all set out free from the walls and can readily be cleaned. In the operating rooms the radiators are set up on platforms two inches above the main floor to allow for flushing the floor without danger of water running down the heating pipes to the floor below.

All buildings are supplied with vacuum cleaning outlets. The apparatus, including an automatic wet tank separator, is placed in the basement.



View of Operating and Subsistence Building, with Solarium in Rear of Main Group (Chelsea, Mass.)



GARDEN ON ESTATE OF EDWARD S. HARKNESS, ESQ., NEW LONDON, CONN.
JAMES GAMBLE ROGERS, ARCHITECT

The Dome of the Panthéon, Paris

A STUDY OF ITS STRUCTURAL SYSTEM

By RICHARD F. BACH
Curator, School of Architecture, Columbia University

SMALLER in diameter by nearly half, but not in any sense less impressive in design than any of the examples thus far analyzed in this series of studies* of domical structural systems, is the dome of the Panthéon in Paris, constructionally the most interesting, architecturally the most effective dome in France, and the finest French church of the eighteenth century.

Like almost all the larger church buildings in Europe the Panthéon was erected to supersede an ancient building of inadequate size and of supposedly antiquated style. The new building is said to have been vowed by Louis XV during an illness at Metz and to have been begun in 1755 or 1757, according to various accounts, although the actual laying of the first stone of the high altar did not occur until 1764, under direction of Jacques Germain Soufflot (1714–80), whose designs were granted the award in open competition. Soufflot had recently returned from an extensive tour of Italy as mentor of the Marquis of Marigny, brother of the courtesan Pompadour and destined by her to occupy the eminent position of surveyor general of public works once held by no less a figure than Colbert. His mind was filled with the classic reactionary feeling, in which the Pompadour herself later abetted him, thus laying the surest foundations for the type of purism usually identified with Louis XVI's time. Soufflot's design was as a firebrand in the camp of the looser style interpreters that hedged about Louis XV. His columnar portico and pediment, his expressive blank wall areas, and, above all, his finely monumental design for dome and drum with peristyle accomplished a revolution in the current architectural manner. It is interesting to note that the style of the building was then called Greek, a building manner at that time known as *le bon goust*.

The church was not completed when the uprising of 1790 opened the eyes of the masses to their own possibilities, and the resulting wave of republican fervor caused a change from the original dedication of the building to the patron saint of Paris, Sainte Geneviève, to the then applicable name of *le Panthéon français*, necessitating a number of changes in decorative features of the building, largely undertaken under the direction of Quatremère de Quincy. In 1806 the building was rededicated to Sainte Geneviève, only to be called a temple again in 1830; in 1851 it became a church once more and, finally, in 1885, was *désaffecté du culte* for the last time when Victor Hugo was interred in the crypt. Since that time it has more and more decidedly assimilated the character of a true Valhalla, more true to its rôle than St. Denis or Westminster Abbey ever was; it is not a little remarkable that a church edifice should so decidedly lend itself to a purpose differing thus widely from that which prompted its erection; but the adaptability of the Panthéon as a memorial edifice is due no doubt to the type of its design, and more particularly to the treatment of the dome and its substructure, not to mention the giant portico, inspired—as were the domes of St. Peter's and of St. Paul's—directly from the ancient example of the original Panthéon, namely that of Hadrian in the Imperial City. In fact, Soufflot set himself the task of adapting the Roman Pantheon motive of dome and portico and elevating the former to the proportions of St. Peter's, so that he might surely overshadow the Dôme des Invalides, built 1680 to 1706.

Various architects were employed from time to time after Soufflot and Quatremère de Quincy; viz., Francois le Romain, Viel de St. Maur, Peyre, and Rondelet, the last named having been especially concerned with the completion of and the improvements subsequently necessary in the dome, the design of which was attacked before its completion by no less an authority than Patte, who was jeered into silence, but not before he had embittered the last years of the architect's life.

II

Soufflot's scheme involved a Greek cross plan, with the major dome at the crossing 265 feet high, and a minor segmental dome over each arm, the smaller domes not expressed in the exterior. A fine Corinthian order is used to separate the aisles from the nave, and the aisles are returned across the ends of the transept arms. At the crossing, however, the columns form the outer angles of triangular piers that serve as the main support of the major dome. The other two angles

*Dome of S. Maria del Fiore, Florence. THE BRICKBVILDER, August, 1916, pp. 209–215. Dome of St. Peter's, Rome. THE BRICKBVILDER, October, 1916, pp. 249–254. Dome of St. Paul's, London. THE BRICKBVILDER, November, 1916, pp. 275–280.

of each of these piers are made by allowing the pier to project forward the distance of an additional intercolumniation into both nave and transept. To disguise the poor effect of these projections, necessarily of solid masonry because of their relatively small size with reference to the work of support expected of them, the suggestion of a second aisle is achieved by placing in line with the outer points of the piers a second row of columns, in which the two central columns on each side of each arm of the Greek cross have been omitted. By this means each of the arms is itself made to appear as a short armed Greek cross, the interior effect being obtained by springing deep semicircular arches, or vaults with narrow soffits, over the space of three intercolumniations lengthwise of the arms of the plan obtained by omitting the two middle columns of the suggested inner aisle. A shallow saucer dome then appears over the remaining open space in each arm of the building, receiving its direct support from slender pendentives rising above the added columns just referred to, and so thin in actual construction as to recall the web of a Gothic vault.

Similar arches were also thrown across nave and transepts, and these together with the inner pier faces form the basic octagon of support for the dome, the octagon in turn being further modified to circular form by the use of pendentives over the piers. The pendentives, decorated by Carvalho's paintings after Gérard, complete the circle with the aid of a heavy entablature which forms the lower line of the drum on the interior.

The plan in print does not adequately convey the manner in which these elements have been made ingeniously to abet one another, and sections on several intersecting planes are necessary to suggest the structural expedients adopted throughout; but while the scheme is praiseworthy, perhaps, as a clever contrivance, the fact remains that the large open space at the crossing was purchased at the expense of the nave and transepts. Justly so, according to some critics, yet we are apt to prefer a more expansive approach to so important a feature as the crowning dome is made to be, and as any crowning dome in modern architecture, placed in the plan as this one is, must be. Too often one meets this difficulty of bringing into harmony the long nave barrel vault or its corresponding feature and the sudden change to the vertical as one is forced to gaze upward into the hollow cylinder of the drum, which in turn so readily depreciates the value of the interior dome and its decorations. The eye seems to require a more definite foretaste of what is to be seen at the crossing, and this is to be obtained only by a broader treatment of the nave and transept approaches.

Panthéon, Paris. View of the Main Facade

Restricting ourselves now to the central portion of the building, we note that the drum rises above the entablature that forms its immediate base, as a true hollow cylinder, without diminution, as at St. Paul's. Its wall is pierced by twelve square headed windows, set about halfway in its inner height, while recesses of equal size are built in above the piers. Between windows and recesses appear sixteen engaged Corinthian columns, set at a level lower than the sills of the windows by

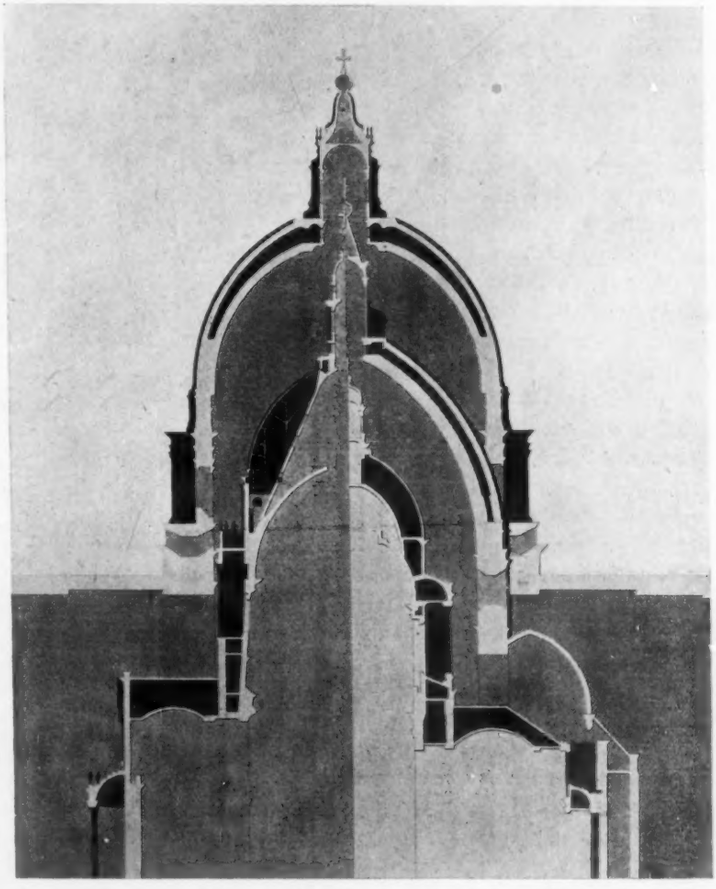
about the height of its entablature, and higher than the base of the drum by approximately twice this height. The entablature of this order forms the springing of the dome visible from within.

As in St. Paul's, the example which Soufflot seems to have used freely as an inspiration, the drum is really composed of a double wall, its two faces anchored together at various levels for structural purposes, but actually built without definite reference to one another except at the window level. Thus in the exterior the drum rests directly upon an octagon of masonry seen above the roof of nave and transepts, representing the solidity of understructure that the eye demands and, according to the records, suggesting a possible original intention of making the entire exterior support of the dome of square plan. Above the octagon appears a circular wall, and upon this is erected the effective exterior peristyle of thirty-two Corinthian columns screening the windows; the entablature of this order is surmounted by a balustrade behind which is a shed roof covering the space between the two walls of the drum. Above this the inner drum continues as an attic wall, varied architecturally by round headed windows set in shallow rectangular recesses, and above the attic wall rises the exterior dome. Several floors of masonry at levels above and below the exterior order, which is of the same height as that on the interior wall, but is set higher by about one-fourth the height of its shaft, break up the vertical space between the two walls of the drum. These floors serve, of course, the structural purpose of binding the two walls together — a necessary expedient because of their entirely distinct systems of support. The necessary light for these passages is obtained by means of a row of rectangular openings set beneath the windows and cut into the stylobate of the inner order, by another row of very small apertures immediately above the entablature of the outer order, and by a third row let into the exterior wall of the drum just below the peristyle.

It should be noted at this point that the two walls of the drum rise from independent supports. While the inner engaged order and the walls below and above rest directly upon the piers, cross arches, and pendentives, the wide soffits of the arches are structurally egregious deceptions. Their effective strength for support appears and is relied upon only at the edges toward the crossing. The remainder of the broad soffit areas are of thin masonry with a hollow space above. The actual support for the outer peristyle and the rectangular mass beneath it must be sought in constructive expedients once more: four giant arches, with diagonal spur walls, erected as part of the fabric above the outer edges of the broad arches mentioned above, which, optically at least, seem adequate for supporting the whole drum. These four invisible arches are segmental in form and span the entire width of the building at the crossing.

III

The dome itself is composed of three shells, following the unexecuted suggestions made by Michelangelo for St. Peter's, and likewise the method of Sir Christopher Wren in the execution

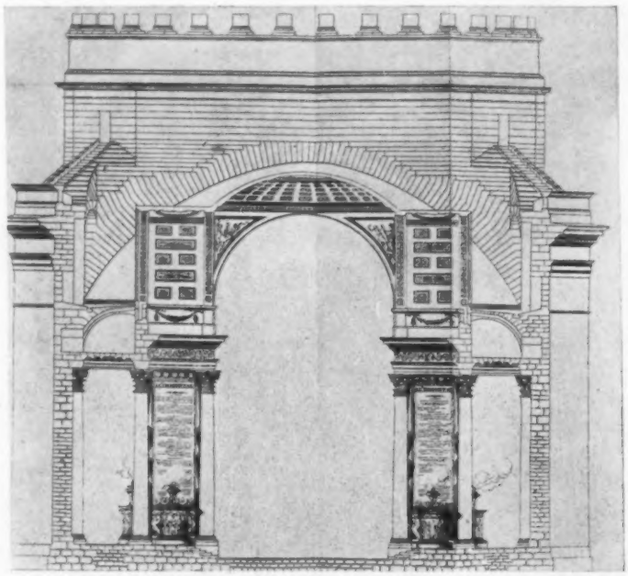


Comparative Sections of Domes of the Panthéon, Paris; St. Paul's, London; Cathedral of Florence and St. Peter's, Rome. (From Dugdale)

of St. Paul's. However, two of Soufflot's shells are of stone, as is also the lantern, and all of the shells are of sections composed of arcs of circles.

The innermost shell is hemispherical and rises directly from the entablature of the inner order of the drum, its thickness diminishing slightly upward. Its surface is decorated with octagonal coffers and its crown is pierced by a large oculus, the deep rim of which provides a frame for the painting on the intermediate shell as seen from the pavement, giving to it a distance and magic perspective that is quite in accord with the idea of the apotheosis motive conveyed by the compositions actually painted on the domical surface.

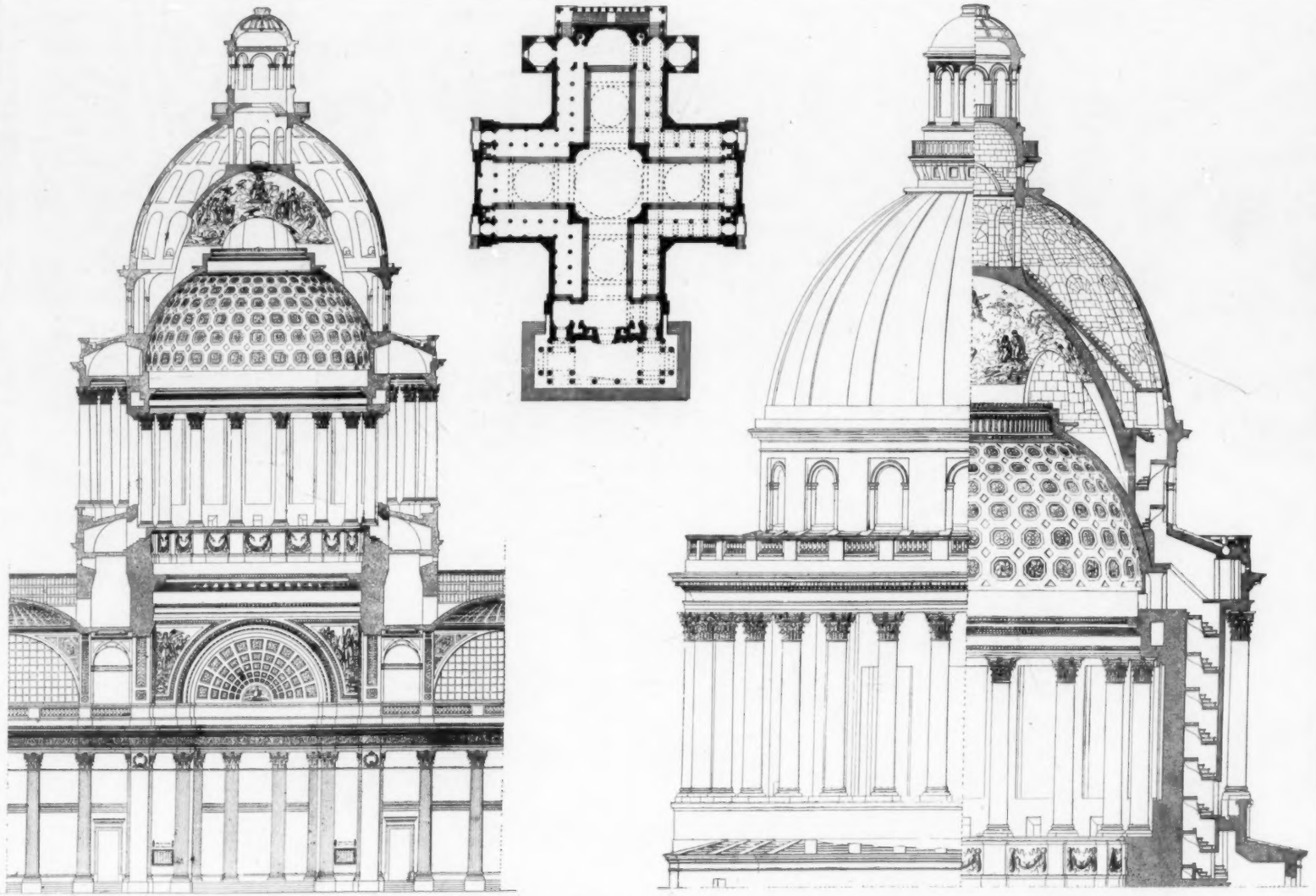
The intermediate shell springs from a level about one-third up the haunch of the inner shell, which has nearly attained the vertical at this line and which, furthermore, gains great strength for support by the presence of the comparatively large oculus opening at its crown. Added support for this shell is given by a solid mass of masonry built across from the base of the attic wall to the inner shell. In section the middle shell is ovoid or elliptical, indicating once more a possible suggestion from St. Paul's, which has a perfect cone for the work of supporting the lantern; but while St. Paul's cone is of brick, with cincture courses of stone, the Panthéon ovoid is of stone. Its haunches are cut by four large, round headed openings or lunettes, which have a span equivalent to three bays of the attic of the drum. These penetrations are contrived so that the entire weight of the intermediate shell is brought to bear upon lines of support that carry down directly to the four major piers below. Through the lunettes light from the windows in the attic wall above the exterior peristyle is permitted to reach the mural paintings by Gros upon the shell's solid crown. The latter directly supports the stone lantern. The stability of this shell is somewhat aided also by two stairways built upon its extrados, connecting below with a spiral staircase contrived between the drum walls behind the blank wall areas above the piers and between the intermediate and outer shells to the springing of the latter, and connecting above with a winding stair on the interior of the lantern.



Section Showing Giant Arches Supporting Drums. (From Rondelet)

The outermost shell is again hemispherical in section, although the exterior disposition of this dome and its accessories gives the impression of a pointed section and is roofed with lead, laid so as to suggest ribs that carry through the lines of solid wall masses in the attic of the drum upon which it really rests. Its thickness is 19 inches at the base, and even this dimension is not maintained, for in the inner face of this shell are constructed four rows or tiers of arched recesses, sixty-four in number, disposed as shallow flat back niches — a type of construction described in French as *vergelé*; these recesses diminish in size as they rise toward the crown, and the spaces they enclose are considerably less than 19 inches thick, perhaps no more than eleven or twelve at most. At the upper level of the attic wall, just at the spring of the outer shell, a masonry floor is built over to the intermediate shell, helping to reduce what little thrust the outer dome may exert. The floor is cut by the four lunettes of the ovoid shell, but so reduces the light available from the windows of the attic that a row of small square openings had to be cut into the outer dome near its base.

The lantern maintains two distinct types of ordinance within and without, as does the drum. Appearing as a simple arcade between the outer and the intermediate shells, upon the latter of which it rests, it rises in slender elegance above the outer dome from which it receives a slight additional support and by which it is buttressed, its base surrounded by a projecting gallery, supported upon heavy brackets between which small square windows are pierced to aid in lighting the



CROSS SECTION THROUGH DOME AND SUB-STRUCTURE
(From Isabelle)

PLAN
(From Simpson)

HALF-ELEVATION AND HALF-SECTION THROUGH DOME
(From Isabelle)

PANTHÉON, PARIS. STRUCTURAL DETAILS

space between the intermediate and outer shells.

In architectural treatment above this point the lantern shows eight round headed openings alternating with engaged shafts, surmounted by a plain dome treatment with cross finial. In the interior the simple arcade above the intermediate shell bears a segmental vault with an oculus in its crown, the latter rising to a line just below the level of the window sills and within the balcony, which is not to be taken as indicating an interior floor level. Above the windows is a coved ceiling or flattened dome, with a large opening in its crown through which is seen the final covering for the lantern, a small dome of wood and lead.

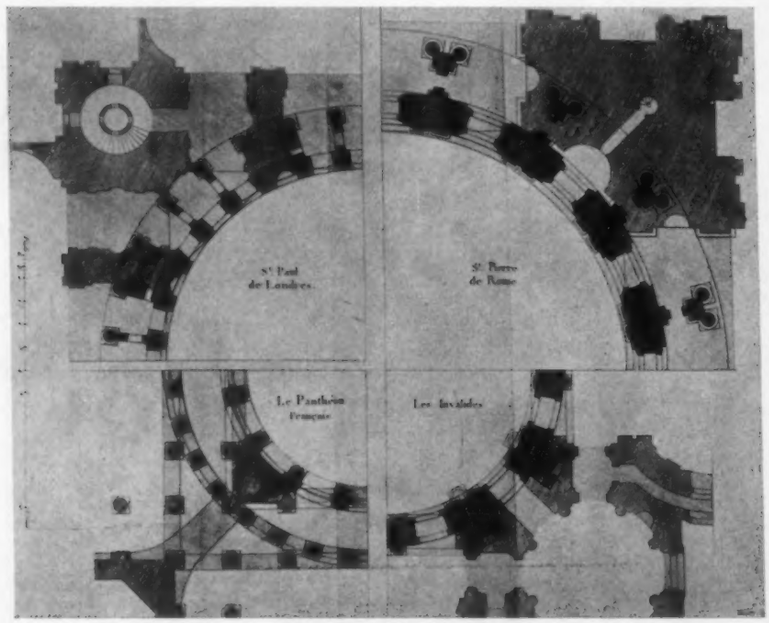
The present gilded cross finial superseded three other motives designed for this position. Soufflot's original terminal feature was removed to give place to a figure of Renown by Dejoux. Later a figure of Immortality was designed by Cortot for this position, but when the building reverted to Catholic uses the erection of the cross finial put an end to these changes.

While the total height of the dome is 265 feet, the inner shell reaches a height of only 188 feet and a diameter of but 68 feet, its oculus measuring 31 feet across.

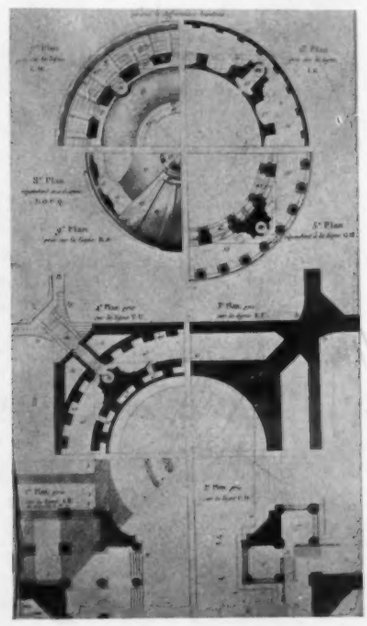
IV

Fully acquainted with the particulars of Soufflot's design, and convinced that the piers were sure to be too weak for the work expected of them, the architect Patte systematically proceeded to ridicule the dome design before its completion, and to point out the difficulties of its construction. He issued and broadly disseminated a "Mémoire sur la construction de la coupole projettée pour couronner la nouvelle église de Sainte Geneviève à Paris," in which he aimed to demonstrate that the piers then executed were inadequate for support of the dome. He adduced a number of famous examples to carry his point, but all of the examples cited are of buildings that have required repeated strengthening. This memoir was published in 1790; Soufflot died in 1780, hounded to death by the adherents of Patte, according to those who believed in him. At that time the drum had just been begun.

Rondelet had been associated with Soufflot, at the latter's request, since 1770, and superintended the construction practically alone from the great interior entablature to the end. No doubt his fine calculations are largely responsible for the success of Soufflot's numerous and intricately related structural expedients. The dome was carried to completion, and, as though to justify Patte's criticisms, a number of dangerous fissures appeared in the supports; in fact, Soufflot himself had noticed and tried to remedy some of these. In 1796 a commission of architects examined the work; in 1797 a commission of engineers covered the same ground, and in 1798 a joint commission



Comparative Plans of Drums and Understructures of the Domes of St. Paul's, London; St. Peter's, Rome; the Panthéon and the Invalides, Paris. (From Rondelet)



Plans of Dome and Understructures of the Panthéon at Eight Levels. (From Rondelet)

from both professions repeated the performance.

The engineers submitted findings to prove that the only safe solution of the difficulty was to provide adequate counter thrust for the dome. For this purpose they recommended the introduction of powerful buttressing arches in the height of the pendentives, supposedly to receive the dome thrust and lead it to the angles of intersection of the outer walls. The architects, realizing that the effect of domes on pendentives is in general centripetal, and that thrust in such domes may be considered as largely converted into load or at least bent to form a line of force or pressure more nearly approximating a vertical, and, furthermore, realizing that the peculiar structural system of this dome was particularly subject to this consideration, recommended nothing more than the strengthening of the piers. However, the actual upshot of all these investigations was that the arches were shored up to prevent the actual disintegration of the edifice, and after some other minor attentions the whole project was abandoned.

The only understanding and clear headed opinions at this time seemed to be those advanced by Jean Baptiste Rondelet, to whom the final execution of the dome is due. Rondelet published in 1797 a "Mémoire historique sur le dôme du Panthéon français," in which he examines in detail the logic of its construction, and then analyzes carefully the exact strength and reliability of all of its parts, the walls and immediate dome supports and their relation to the work they have to do, and finally the various defects which have occurred in the structure, notably in the piers, their causes and the means for remedying them permanently. Rondelet's studies really rehabilitated the good name of Soufflot as a builder, for it was demonstrated that the chief difficulty arose from the use of poor masonry and of brittle stone for the piers, due to the short sighted economies of an unappreciative clergy during the last decades of the preceding century. In this connection one is reminded of Wren's use of inferior stone in St. Paul's, because of difficulties in obtaining the desirable Portland stone, and because he considered it wise to commit the professional transgression of trying to complete his masterwork within his own lifetime. But in the French example the transgression was not the architect's.

Rondelet's publication was accompanied by excellent plates — none better have been issued to date — showing all parts of the edifice, with numerous illuminating sections, plans, and constructional diagrams. Under his direction the piers were strengthened, chiefly by approximately doubling their girth, doing away with the corner columns of the original design, and adding pilasters in their stead. The resulting added strength sufficed to set all questions of stability finally at rest, and the primary recommendations of the investigating commission of architects in 1796 that the solution lay in the strengthening of the piers were thus substantiated.

In 1814 Rondelet published a new edition of his original study, with an additional discussion of the means employed in restoring the piers. This was accompanied by a number of new plates, giving all possible plans, sections, and views of the building; drawings showing the processes of shoring the arches while the work was in progress; plans showing the exact amount of material added to the piers and the resultant effect upon the design; and finally, even a plan showing the exact locations under the building of a surprising number of clay pits which had been filled to give proper foundation for the edifice. These pits caused numerous difficulties of settlement, because they had been filled with solid masonry, and may have had much to do with the weakening of the piers, due to uneven compression of earth beneath them.

V

Taken as a whole, the Panthéon is a bold and a clever piece of construction, as even a cursory study of its plan and section will indicate at once. The amount of masonry needed was evidently reduced to a minimum, in fact, even seems to have exceeded that dangerous structural extreme, although we are willing to believe that, given good stone well handled and with proper foundations, Soufflot's piers would probably have been adequate.

As to the appearance of the dome as a whole, it should first be said that the exterior immediately suggests St. Paul's in London, but with the difference that the tall continuous peristyle offers no suggestion of buttressing for the dome. Structurally there is provision for such buttressing for the inner shell in the intercolumniations just above the four piers, masonry masses containing spiral stairways set back behind the frontal plane of the columns and disposed as are the corresponding masses in St. Paul's; but the expedient looks inadequate, although experience proves the contrary. The intermediate shell profits by the same arrangements, and, being ovoid in section, requires much less counterthrust and so does not very appreciably increase the work of the existing counteracting members. The weight of the intermediate shell is likewise greatly reduced by the four large openings cut into its base.

Some of the other buttressing expedients employed might also be noted here. In the first place, the engaged inner order of the drum is relied upon as a meager part of a buttressing system for the dome, and also gives direct support for the two inner shells. Again the masonry just beneath the large inner entablature upon which the drum apparently rests is corbeled out strongly, to aid in counteracting thrust from the dome. It was at this level that serious defects appeared in St. Peter's. To assist in counteracting the outer shell's thrust, and partly also to operate against that of the ovoid shell, the wall of the attic of the drum is made of almost triple thickness in all spaces between windows. Two other vaulted members are introduced to serve as buttresses between the two walls of the drum, one below the outer base of the peristyle and one just above its entablature; both are contrived as a series of penetrations in a half barrel vault.

* * * * * * *

Our study has demonstrated that the architect was able to devise multifarious expedients to make permanent a structure similar to those which in all other great historical examples required chains and cinctures of wood to bind them, despite the use of comparatively heavier supports. The ingenuity of the designer has not militated against the success of his design; though the stability of his structure was endangered, the fortunate presence of his collaborator, Rondelet, saved the work and it still stands as the most impressive domical monument in France. Upon Soufflot's tomb we read that he had no other master than nature; if he learned his ingenuity from nature alone, his wisdom carried him dangerously near the brink of catastrophe, and yet withal most of us that study the Panthéon can learn much from his cleverness.

Bibliographic Note. For the benefit of those whose interest may prompt them to a further examination of the interesting problem of construction presented by the dome of the Panthéon, the following list of references is appended: Dilke: French Architects and Sculptors of the 18th Century, London, 1900; Dugdale: History of St. Paul's Cathedral, London, 1716; Gosset: Coupoles d'Orient et d'Occident, Etude Historique, Théorique et Pratique, etc., Paris, 1889; Isabelle: Les Édifices Circulaires et les Dômes Classés par Ordre Chronologique et Considérés sous le Rapport de leur Disposition, de leur Construction et de leur Décoration, etc., Paris, 1855; Legrand et Landon: Description de Paris et de ses Édifices, avec un Précis Historique et des Observations sur le caractère de leur Architecture et sur les Principaux Objets d'Art et de Curiosité qu'ils Renferment, Paris, 1806; Patte: Mémoire sur la Construction de la Coupole Projetée pour Couronner l'Eglise de Sainte Geneviève, Paris, 1770; Rondelet: Mémoire Historique sur le Dôme du Panthéon Francaise, Paris, 1797; Rondelet: Mémoire Historique sur le Dôme du Panthéon Francaise ou Nouvelle Eglise de Sainte Geneviève . . . avec une addition sur la Construction de cette Eglise dans laquelle on indique le Procédés employés pour la Restauration des Piliers du Dôme, etc., Paris, 1814; Simpson: A History of Architectural Development, New York, 1913, vol. 3; Ward: The Architecture of the Renaissance in France, etc., London and New York, 1911.

Panthéon, Paris. View of Transept and Dome

CLOCK TOWER AND SHOPS

MARKET SQUARE GROUP, LAKE FOREST, ILL.

HOWARD SHAW, ARCHITECT

GROUND PLAN

VIEW SHOWING FOUNTAIN AND SHOPS

MARKET SQUARE GROUP, LAKE FOREST, ILL.

HOWARD SHAW, ARCHITECT

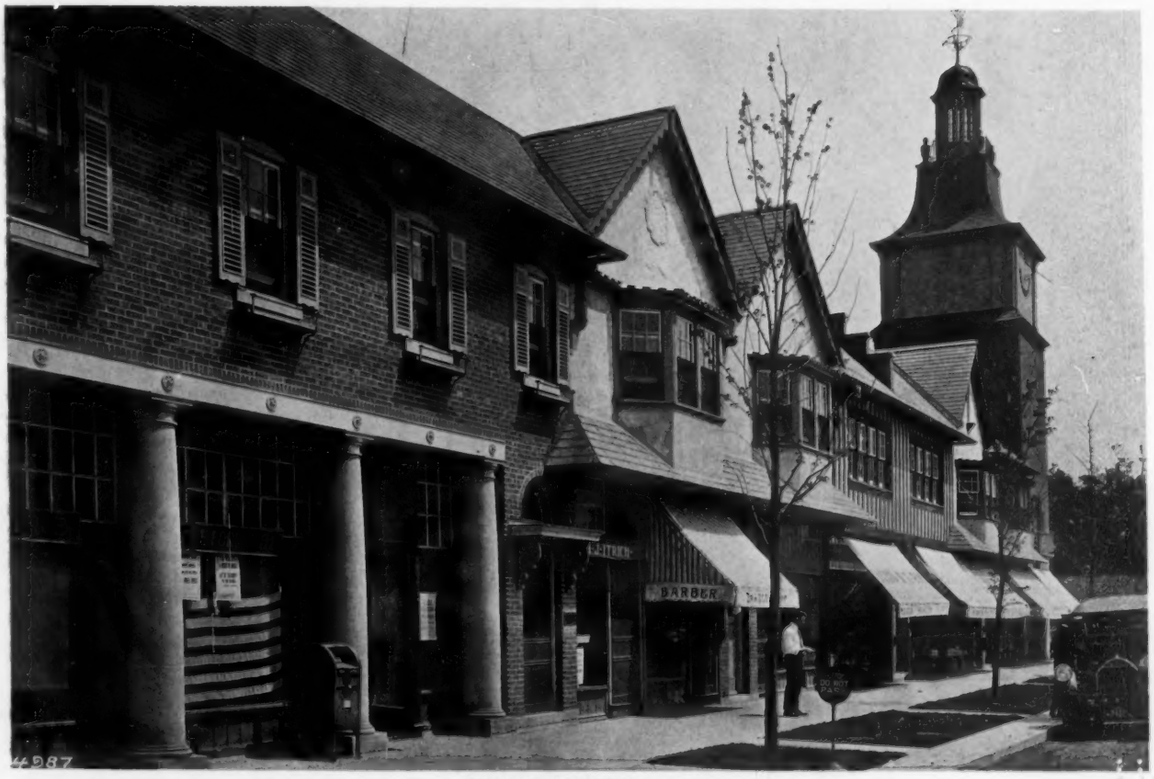
VIEW ALONG WESTERN AVENUE SHOWING OPENING TO MARKET SQUARE

BANK AND PUBLIC UTILITY BUILDING

MARKET SQUARE GROUP, LAKE FOREST, ILL.

HOWARD SHAW, ARCHITECT

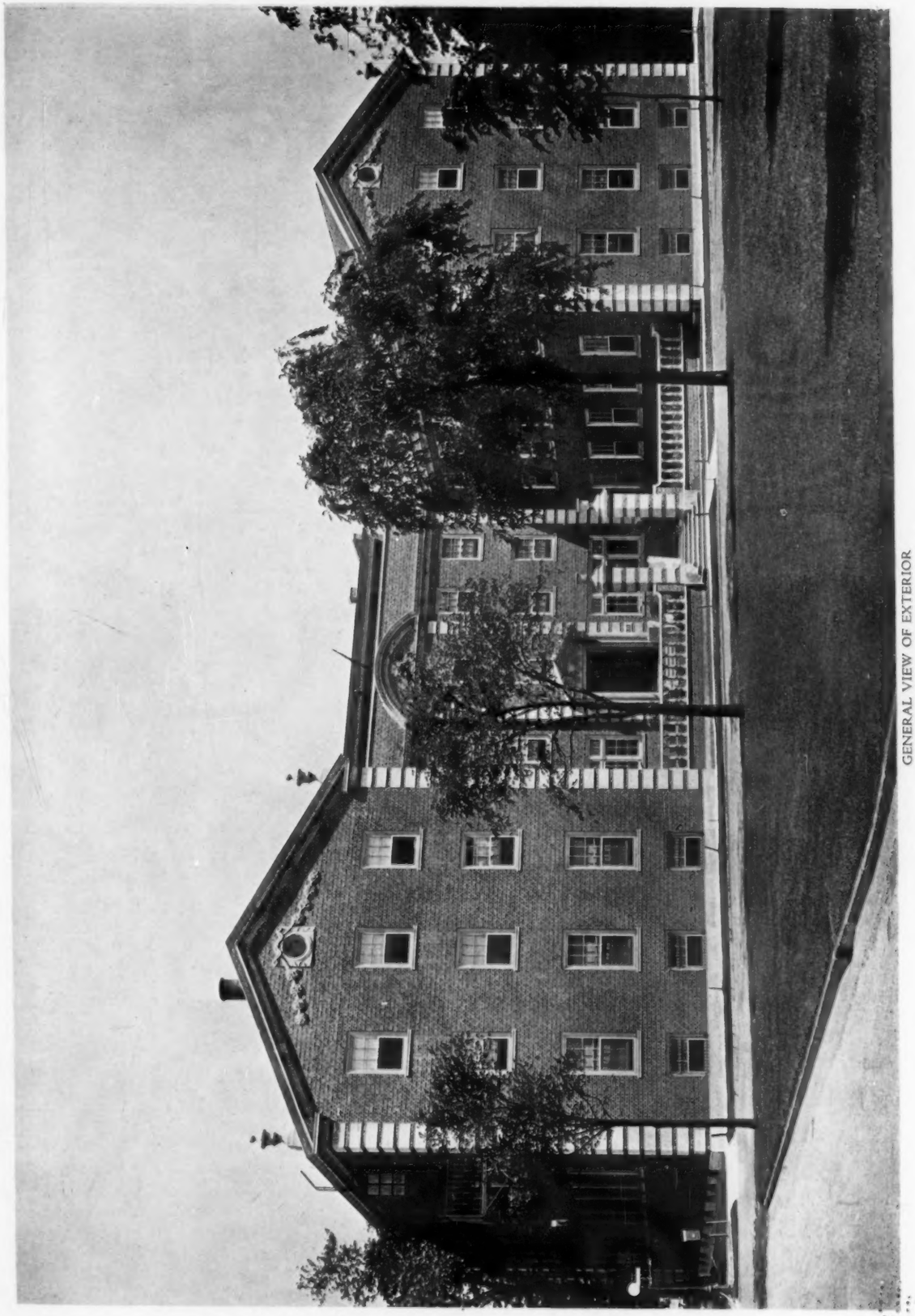
SHOPS ON SOUTH SIDE



SHOPS ON NORTH SIDE

MARKET SQUARE GROUP, LAKE FOREST, ILL.

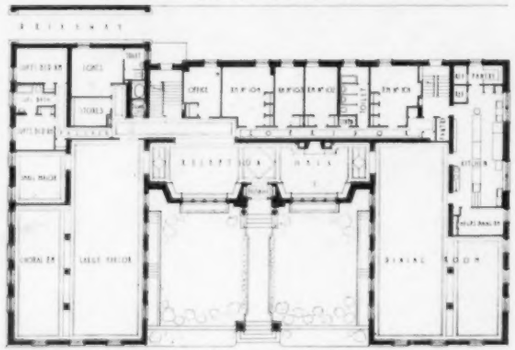
HOWARD SHAW, ARCHITECT



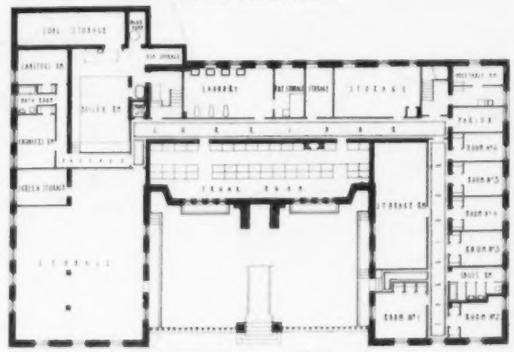
GENERAL VIEW OF EXTERIOR
ELEANOR CLUB, CHICAGO, ILL.
RICHARD E. SCHMIDT, GARDEN & MARTIN, ARCHITECTS

VIEW OF RECEPTION HALL

SECOND AND THIRD FLOOR PLAN



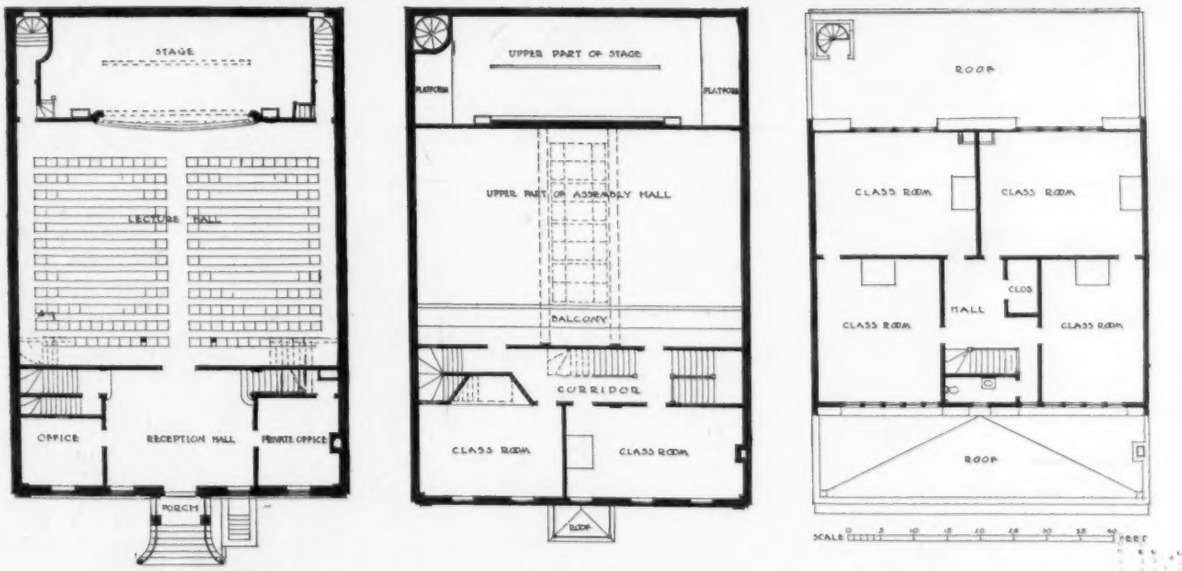
FIRST FLOOR PLAN



BASEMENT FLOOR PLAN

ELEANOR CLUB, CHICAGO, ILL.

RICHARD E. SCHMIDT, GARDEN & MARTIN, ARCHITECTS

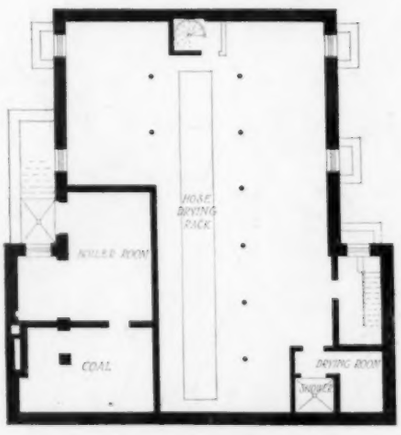


FIRST FLOOR PLAN SECOND FLOOR PLAN THIRD FLOOR PLAN

LELAND T. POWERS SCHOOL, FENWAY, BOSTON, MASS.

ALLEN W. JACKSON, ARCHITECT

GENERAL VIEW OF EXTERIOR



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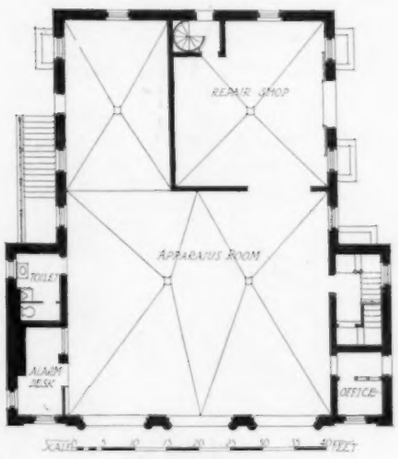

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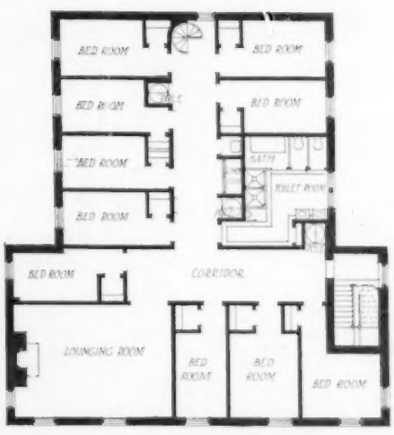
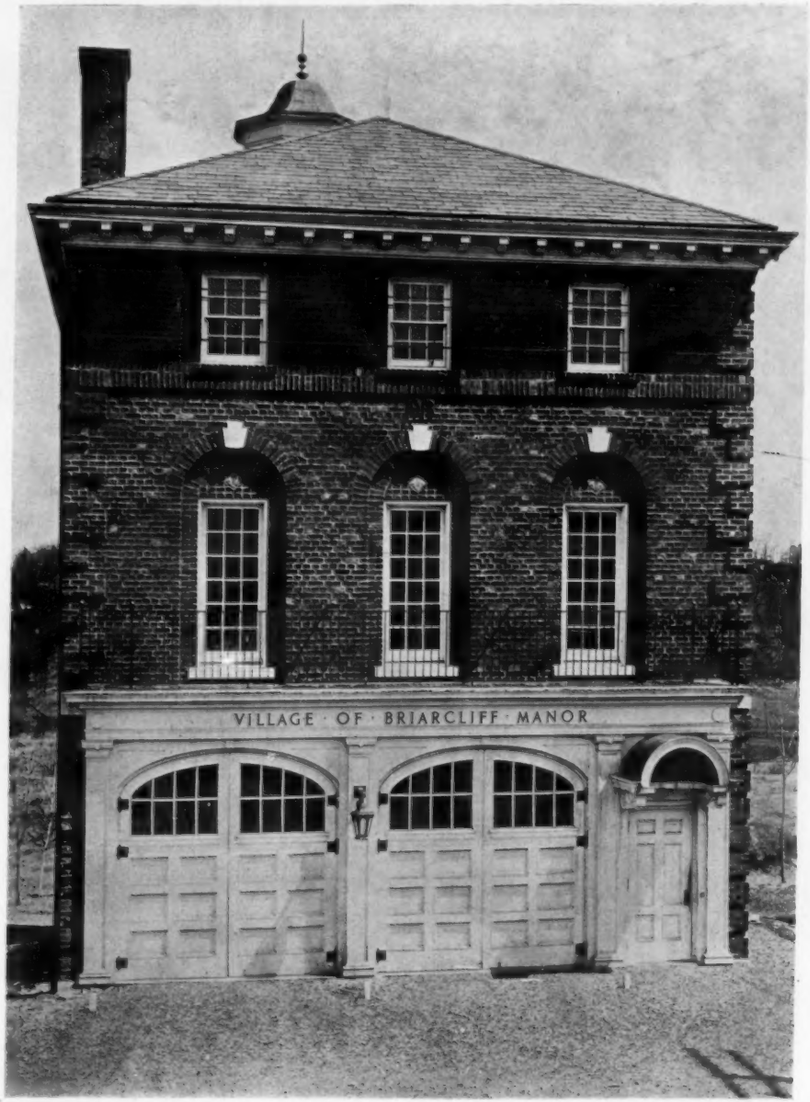


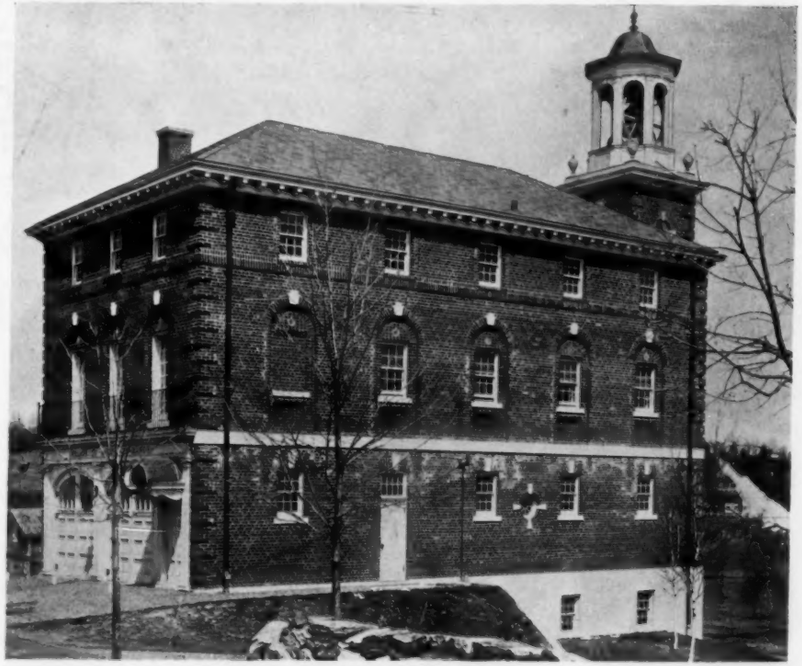
SECOND FLOOR PLAN

FIRE STATION, SALEM, MASS.

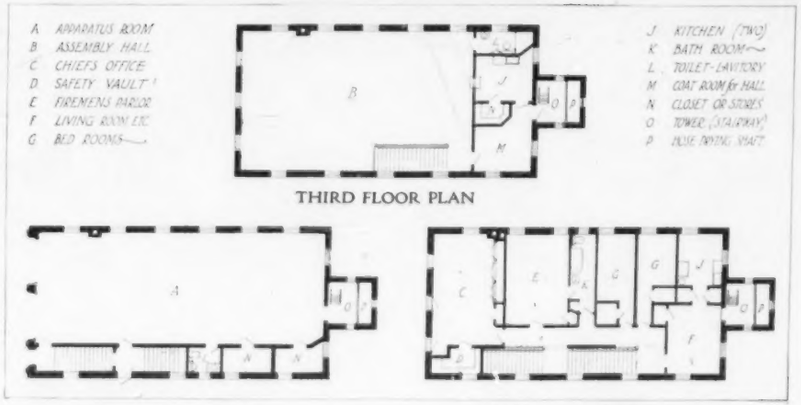
KILHAM & HOPKINS, ARCHITECTS



FRONT ELEVATION



GENERAL VIEW FROM SIDE



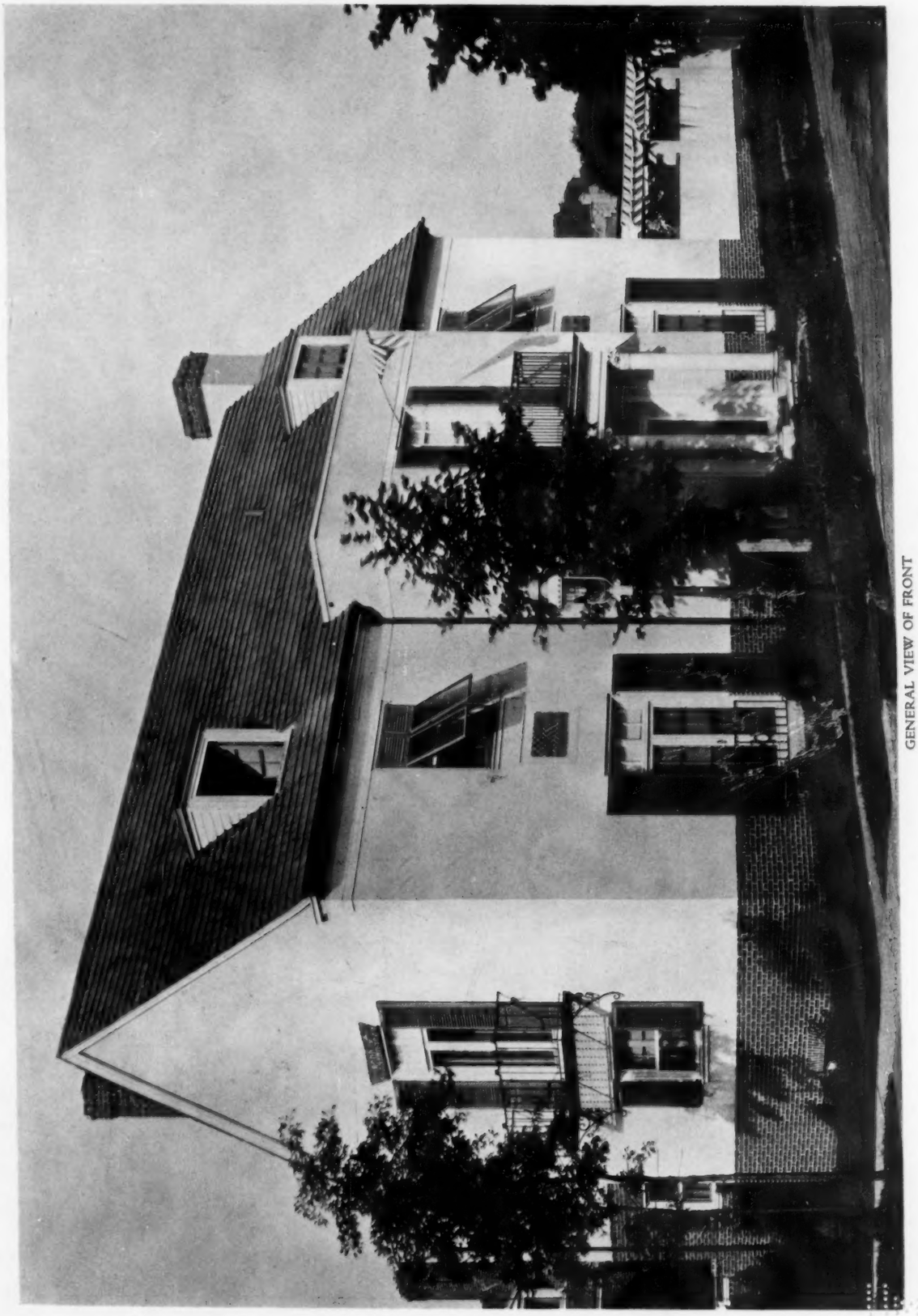
THIRD FLOOR PLAN

FIRST FLOOR PLAN

SECOND FLOOR PLAN

FIRE STATION, BRIARCLIFF MANOR, N. Y.

BATES & HOW, ARCHITECTS



GENERAL VIEW OF FRONT

HOUSE AT LINDEN COURT, ST. MARTINS, PA.

EDMUND B. GILCHRIST, ARCHITECT

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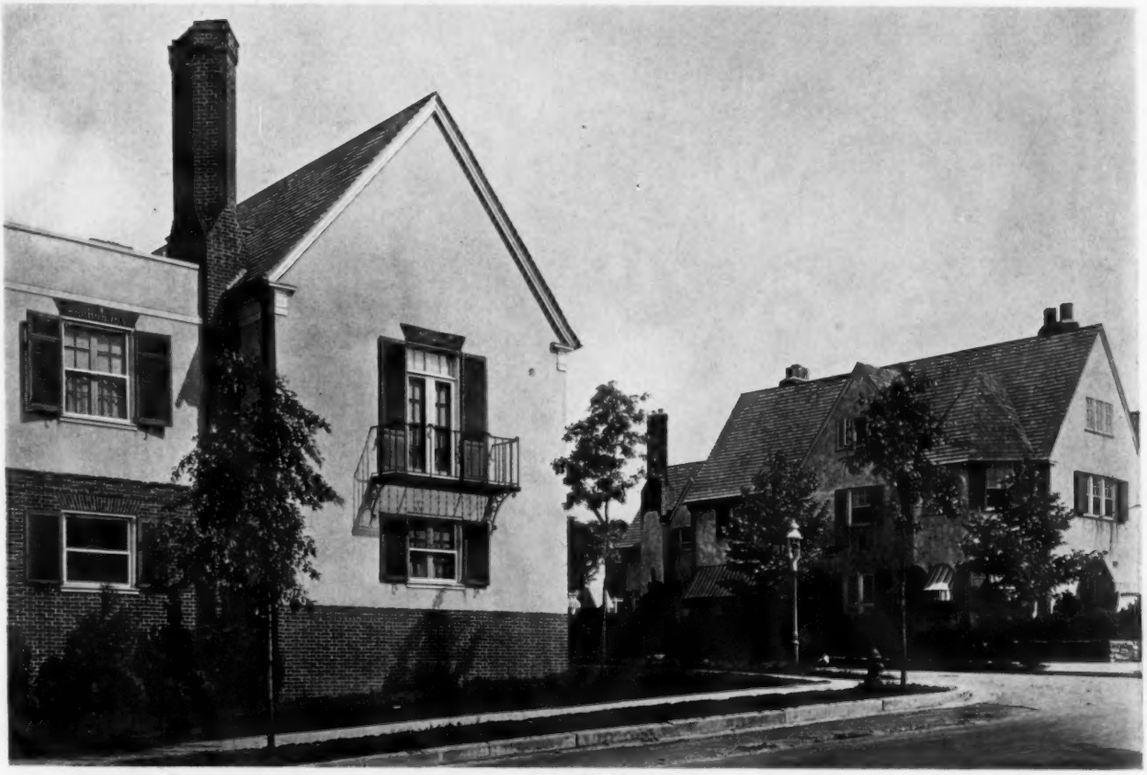
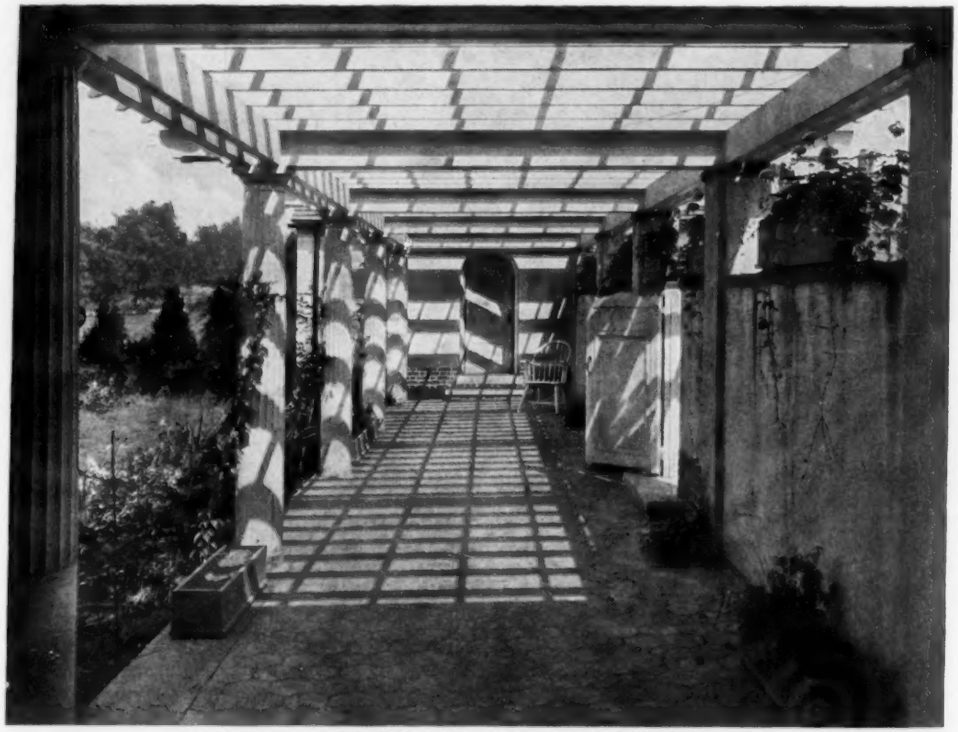


VIEW OF END TOWARD STREET

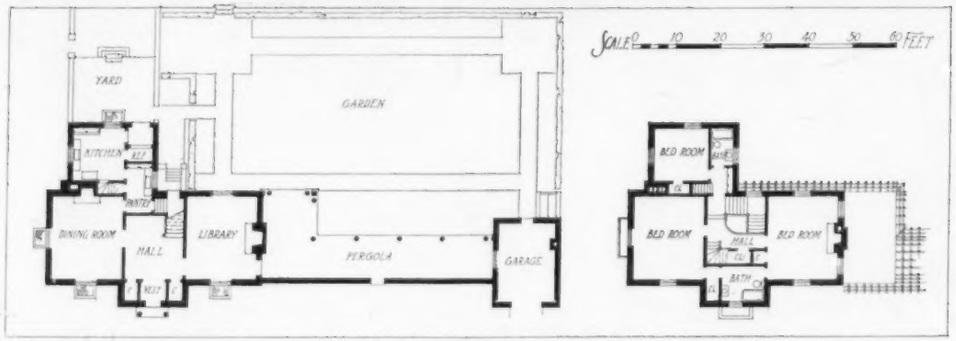
VIEW OF GARDEN SIDE

HOUSE AT LINDEN COURT, ST. MARTINS, PA.

EDMUND B. GILCHRIST, ARCHITECT



VIEW IN PERGOLA LOOKING TOWARD GARAGE

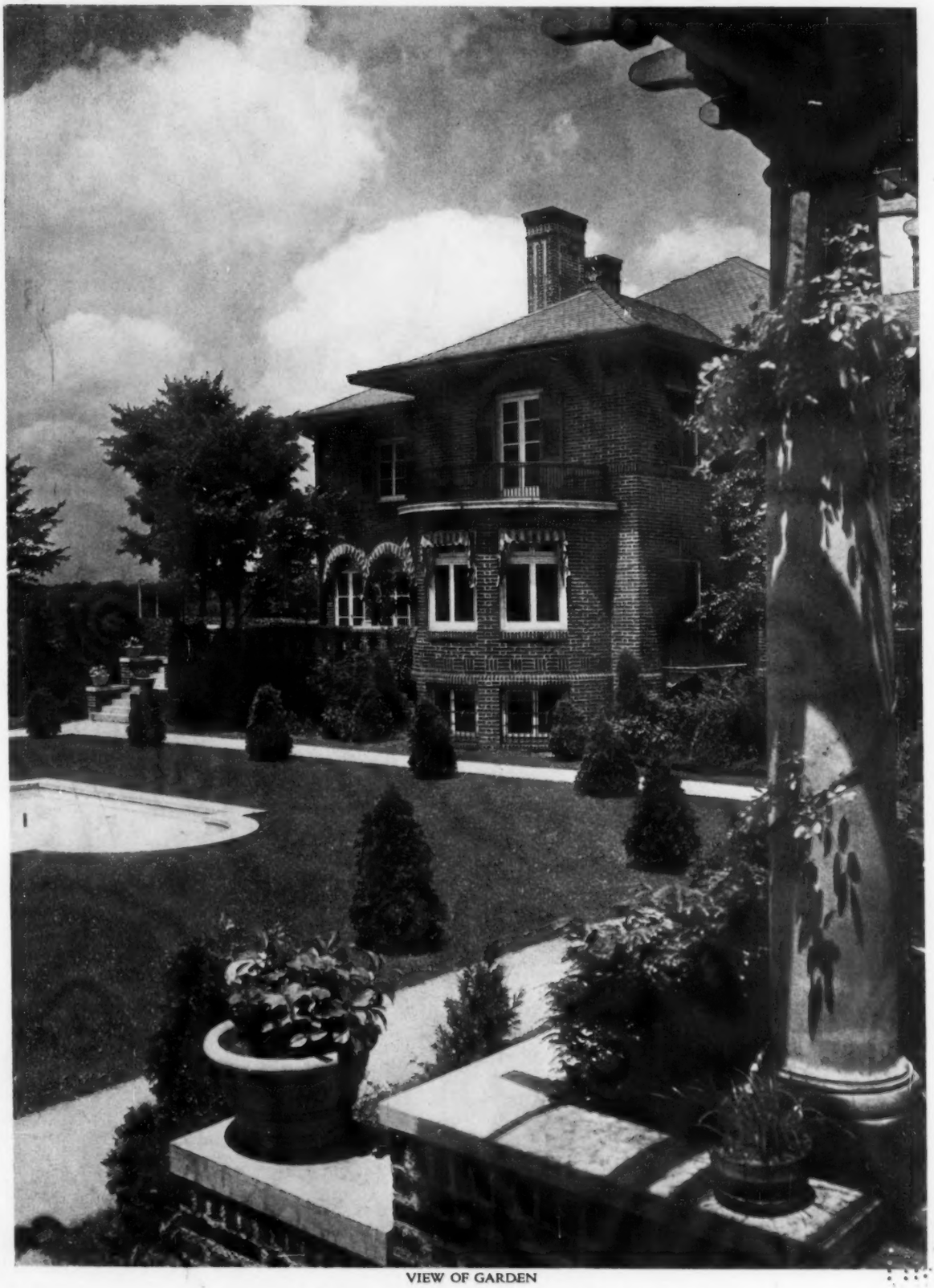


FIRST AND SECOND FLOOR PLANS

DETAIL OF ENTRANCE

HOUSE AT LINDEN COURT, ST. MARTINS, PA.

EDMUND B. GILCHRIST, ARCHITECT

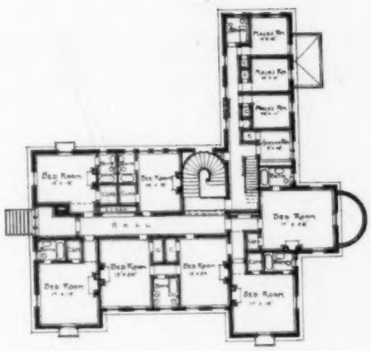


VIEW OF GARDEN

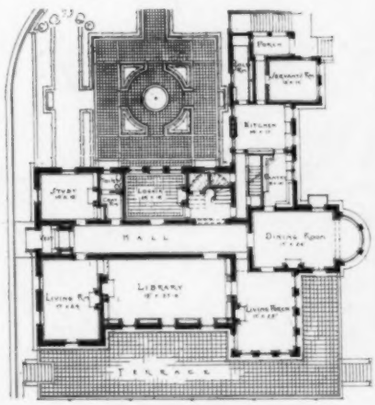
HOUSE OF FERDINAND HOWALD, ESQ., COLUMBUS, OHIO

HOWELL & THOMAS, ARCHITECTS

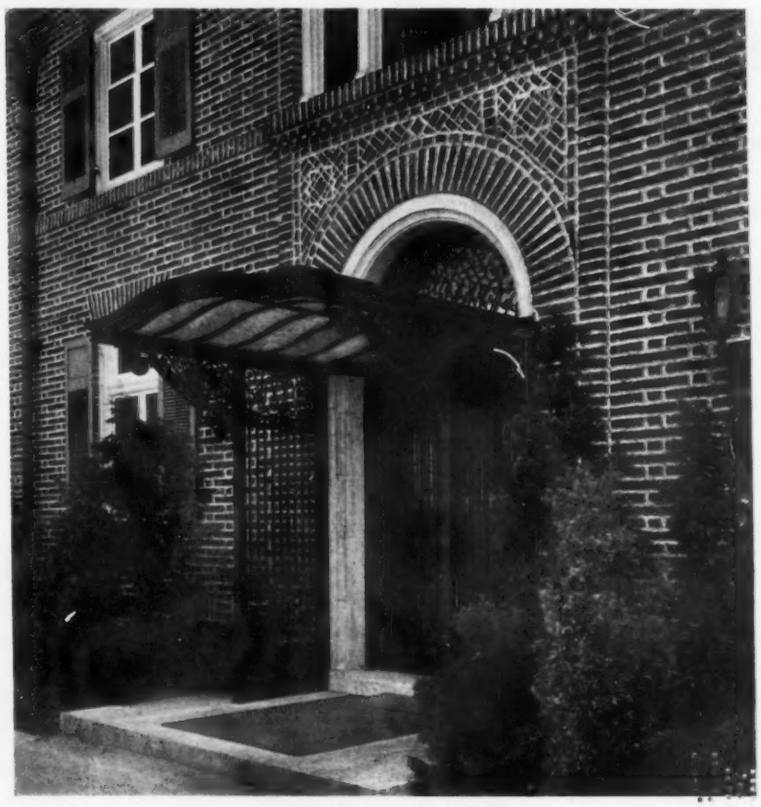
VIEW OF GARDEN FROM PERGOLA



SECOND FLOOR PLAN



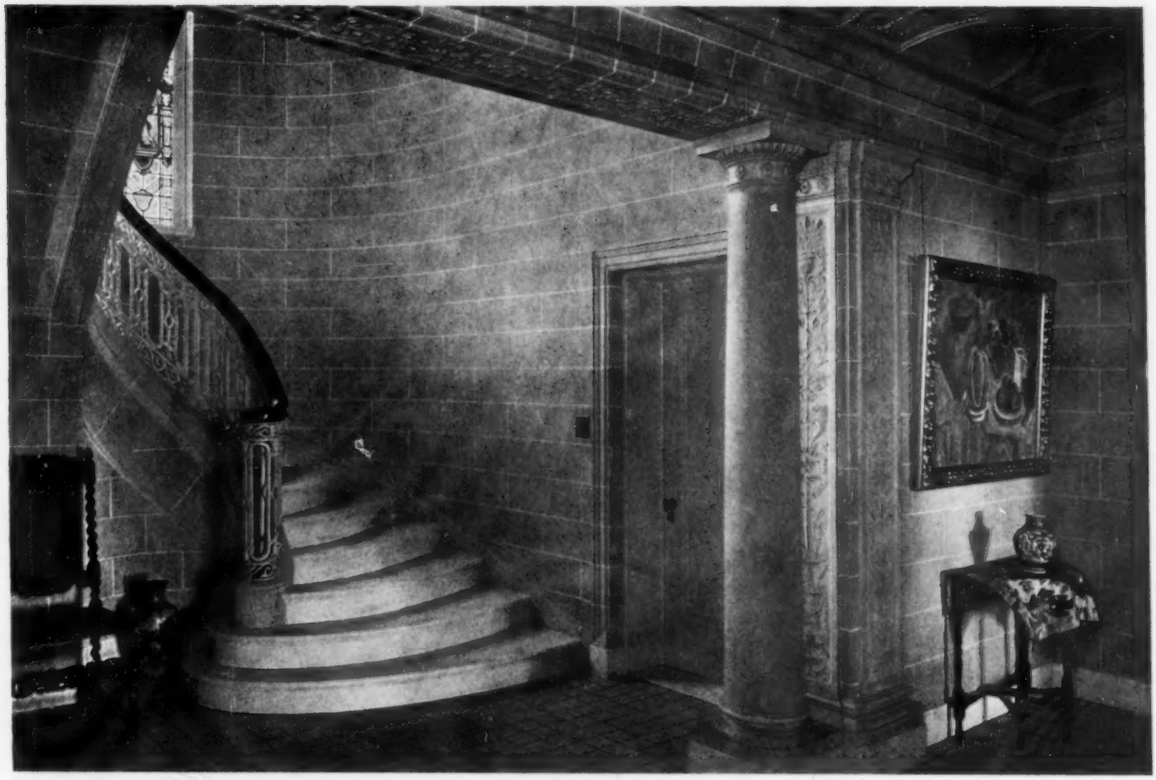
FIRST FLOOR PLAN



DETAIL OF ENTRANCE

HOUSE OF FERDINAND HOWALD, ESQ., COLUMBUS, OHIO

HOWELL & THOMAS, ARCHITECTS



VIEW OF STAIR HALL

VIEW OF DINING ROOM

HOUSE OF FERDINAND HOWALD, ESQ., COLUMBUS, OHIO

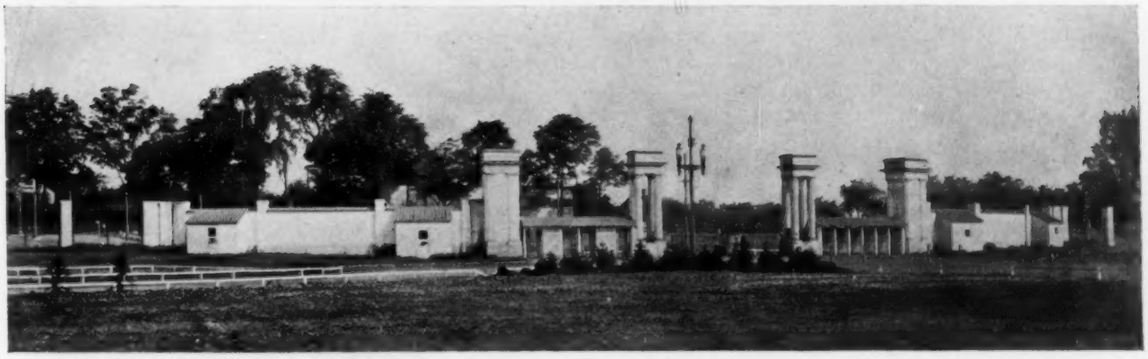
HOWELL & THOMAS, ARCHITECTS

VIEW OF TERRACE SIDE

VIEW LOOKING FROM FORMAL GARDEN TO LOGGIA

HOUSE OF FERDINAND HOWALD, ESQ., COLUMBUS, OHIO

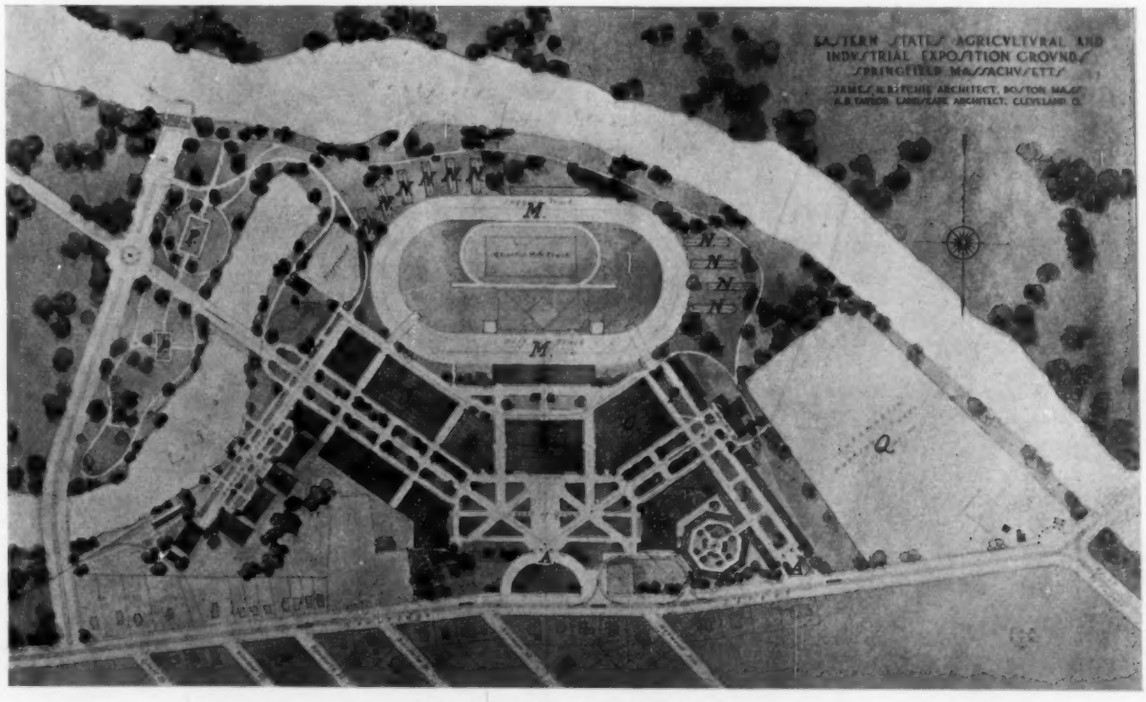
HOWELL & THOMAS, ARCHITECTS



Eastern States Agricultural and Industrial Exhibition Group, Springfield, Mass.

JAMES H. RITCHIE, ARCHITECT

THIS large group of buildings at Springfield, Mass., houses an educational institution of unique character. It has for its purpose the development of agriculture in the Eastern States and a closer coördination between this and other industries of New England. Its ambition is to make this region self-sustaining in food production and to promote among the people a demand for home-grown products with the ultimate aim of solving the problem of reducing the cost to the consumer. The project was started two years ago with funds raised through subscriptions of influential men interested in the movement, and a popular campaign carried on in the region of Springfield in which $580,000 was realized in ten days. The New England States have also taken an interest in the project and they are each committed to the program of erecting a permanent



General Plan of Exposition Grounds and Buildings

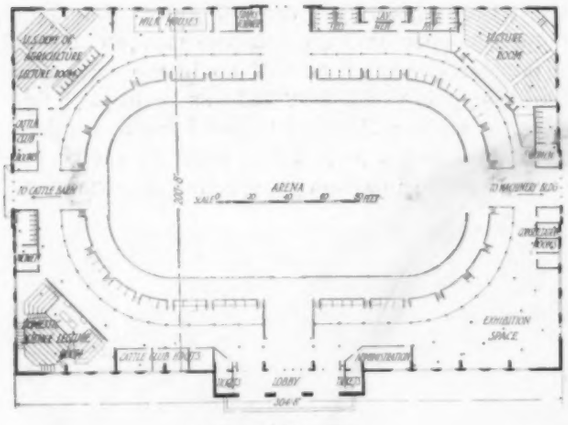
A Main Entrance
B Coliseum
C Exhibit Building
D Women's Building
E Boys' and Girls' Exhibits
F Poultry Building
G Agriculture
H Pigs and Swine
J Cattle Building
K Horse Show
L Grandstand and Restaurant
M Half-mile Track
N Racing Stables
O Blacksmith Shop
P Amusement Building
Q Auto Parking

state building which will provide a rendezvous for the people of the state and also display its agricultural resources. Massachusetts has already appropriated $50,000 for its building, and construction is to start at an early date.

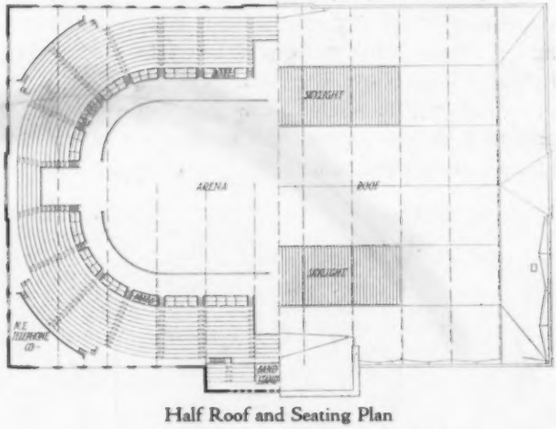
The property lies in West Springfield, just across the river from the Municipal Center of Springfield, and is reached by trolley and good automobile roads. It is a tract of about one hundred and sixty-two acres bordering on the banks of the Westfield River. There is a continuous dike along the banks of the river to prevent flooding of the grounds at periods of the year when there is extreme high water. The lagoon which is being developed and improved is part of the old bed of the Westfield River and is a natural waterway. The avenue leading southwest from the Court of Honor and crossing the lagoon is on the axis of the Municipal Tower of the city of Springfield on the other side of the river. This avenue also gives direct connection with a very large and imposing bridge now about to be erected connecting Springfield with West Springfield.

The general plan of the exposition as shown in the illustration herewith was determined largely by the location of the race track, which was installed before the work of developing the complete plan was undertaken. This track is reported to be the fastest one-half-mile dirt track in the United States.

The plan has recently been revised somewhat from the arrangement shown here, and the avenue of states indicated as facing the lagoon has been transferred to the avenue adjacent to the parking space which is marked in this plan "amusement section." This was found advisable owing to the necessity for increased buildings for exhibition purposes and because it was not thought best to



Ground Floor Plan



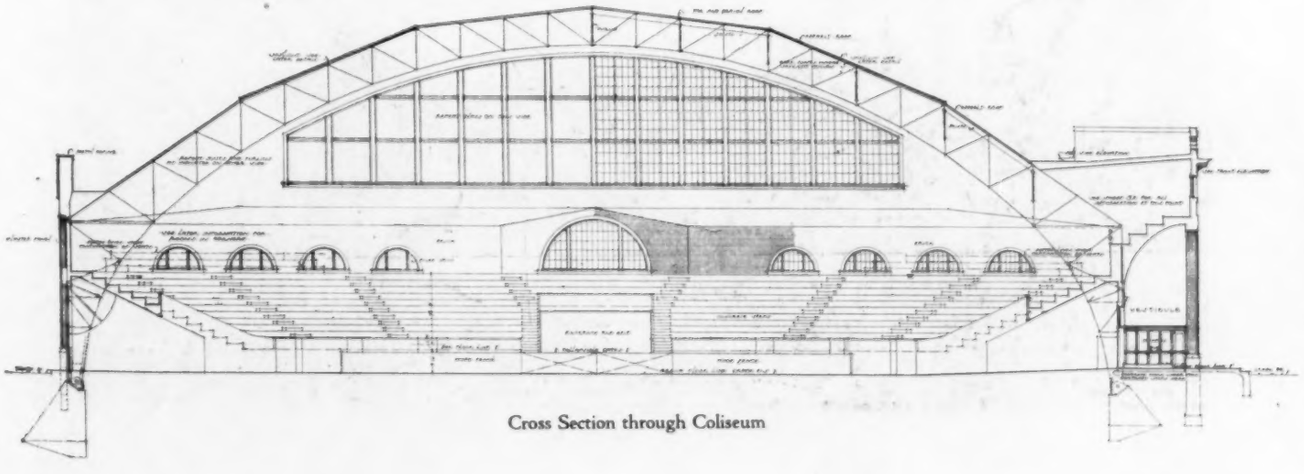
Half Roof and Seating Plan

General View of Coliseum from Main Entrance

Interior of Coliseum

put the state buildings in such close proximity to the freight storage yard. The automobile parking space has been contracted somewhat in the later plan as it was found to be needlessly large, but even with its reduced area there is accommodation for 5,000 automobiles. The racing stables shown on the plan were erected last year and accommodate about 200 horses in box stalls.

The coliseum located on the main axis opposite the entrance to the grounds is 300 feet long and 200 feet deep. The construction of this building is of unusual character ; its roof is supported by 10 steel trusses, weighing about 30 tons each, 72 feet high, and spanning the entire 200 feet — one of the largest spans in the country. The end trusses carry the curtain wall with the large glass opening and also the framing of the flat roof at each end of the building. The trusses were erected in approximately ten working days and established a record for speed in this section of the



Cross Section through Coliseum

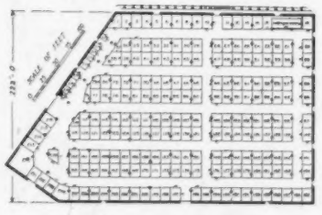
DETAIL OF ENTRANCE TO COLISEUM

EASTERN STATES AGRICULTURAL AND INDUSTRIAL EXPOSITION GROUP, SPRINGFIELD, MASS.

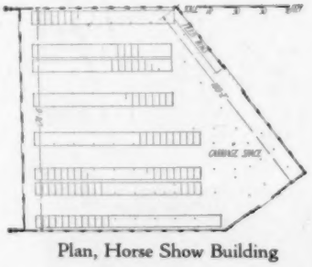
JAMES H. RITCHIE, ARCHITECT

General View of Exhibit Building

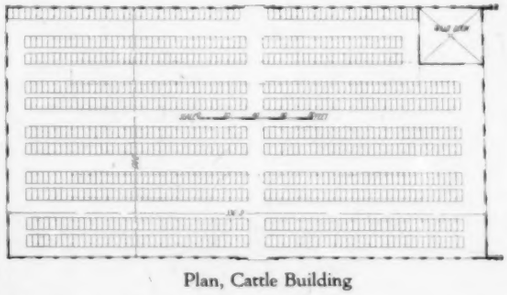
country. The foundations are designed to resist the thrust, and the walls of the building are supported on reinforced concrete beams, 8 to 9 feet deep, spanning the distance between the truss footings, with pockets on the inner side to take the trusses. The weight of the beams and walls increases the load on the footings and guards against their sliding—a condition which otherwise would be possible because of the character of the ground. The trusses are erected without tie-rods at the base, inasmuch as it was not possible to place them more than 2 feet below the floor level, which would render the floor unfit for exhibition tanks or brine pipes for creating an artificial ice rink which may be incorporated as a later feature. The roof structure is of wood rafters carried by the trusses. The steep slopes were laid in asphalt and the flatter slopes in five-ply tar and gravel. The skylights are of the



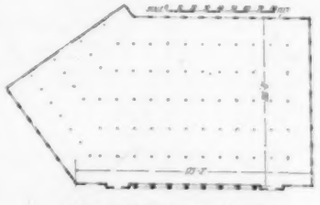
Plan, Exhibit Building



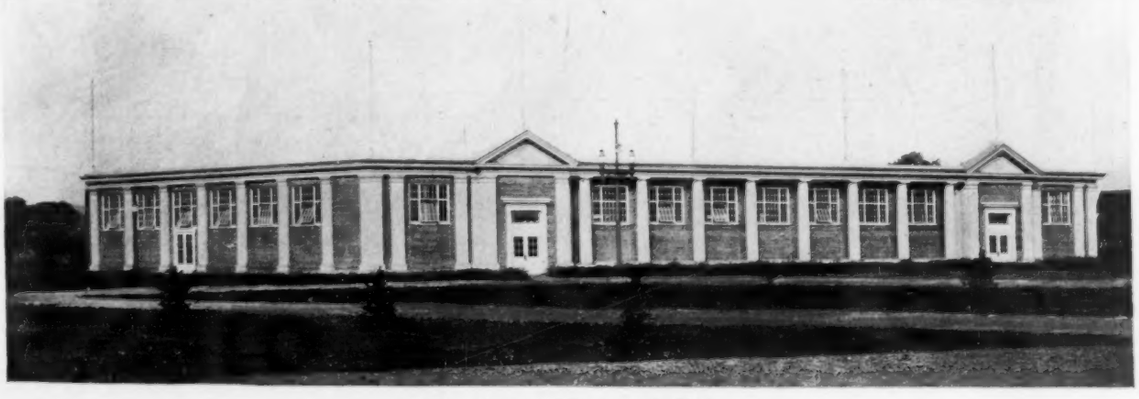
Plan, Horse Show Building



Plan, Cattle Building



Plan, Women's Building



General View of Women's Building

self-supporting anchor bar type. The exterior walls are of selected local red brick trimmed with terra cotta and tile. In the spandrels between the arches east and west of the central motif, executed in colored faience, are the seals of the six New England States, each nearly 4 feet high. The frieze of the central motif is polychrome terra cotta and tile executed in blues, gold, and crimson. The building is practically fireproof and cost in the vicinity of $250,000.

Including the lecture rooms in three of the corners, the building will accommodate at one time, in round figures, 10,000 people. The seating capacity of the main amphitheater, including boxes, is about 6,700, and the main promenade around the ring will easily accommodate 1,500 people standing and still allow ample room for circulation. The ring is 96 by 200 feet, a trifle larger than that in Madison Square Garden, New York. The large doorways on the east and west walls of the building are arranged with portable mullions so that they may be taken out and the upper part of the doorway swung up, leaving a clear passageway 19 feet wide and 22 feet high, with openings of corresponding size in the exhibit and horse show buildings. The columns in each of these buildings have been so spaced that with these large openings there is a "straightaway" of over 800 feet with a start in the horse show building, continuing through the coliseum and finishing in the exhibit building. This feature which enables horses to pass through the ring at top speed is not found in any other group of buildings in the United States.

The exhibit building has an area of 66,600 square feet, which was found, however, to be insufficient for the exhibition held in the grounds last year, and plans are now under way for a 50 per cent increase in its area.

The cattle and horse show buildings are splendidly lighted by a monitor type of roof and skylights similar to those in the coliseum. The roofs are of mill construction with heavy hard pine framing combined with steel. During the exposition of last year both of these buildings were used for the housing of prize herds. The two combined accommodated, in stalls 3½ by 4 feet, over 1,000 head of cattle. That portion of the women's building facing on the Court of Honor and the first three bays on the avenue opposite the exhibit building was erected during 1916. Plans for the immediate future contemplate the completion of this building, the new part of which will be for the exhibition of handicraft of boys and girls.

Under construction at the present time is a sheep and swine building and a temporary poultry building. Future plans call for a permanent building, however, which will be located on the Court of Honor opposite the women's building.

Immediate plans further contemplate a concrete and steel grand-stand and restaurant building to cost $100,000 and to seat 7,500 people.

The ground on which the buildings are located is below the surface drain line of the surrounding streets, and this fact determined a method of drainage which, in addition to being efficient and economical to operate, contributes largely to the picturesque appearance of the grounds. A series of open moats was installed with all the roads pitching toward them. At certain points they are covered over with concrete slabs forming aqueducts and during the exposition periods the moats are flooded with water and changed frequently.

View of Coliseum from Entrance at Night

Possible Uses of the Flat Roof

By RAYMOND M. ROBINSON

BRIEFLY, the purpose of this article is to suggest that a greater attempt be made to render the flat roof useful.

Look down upon the congested business districts of any of our large cities from a high point of observation. Everywhere is evident the desire to work each foot of ground to its greatest capacity, to reach higher into the clouds when expansion in any other direction is no longer possible. Yet we see spread out before us, all over the city, acres of flat roofs — the roofs of office buildings, hotels, factories, warehouses, department stores — bare and unused. Is it because this space is unadaptable to the needs of tenants? It is far more likely that the owners of these buildings — and their architects — have overlooked the fact that these areas might well serve countless purposes.

To be sure, we occasionally find a flat roof endeavoring to make itself useful. The so-called roof garden, generally a beer parlor which derives its name from the artificial grapevine which decorates its colonnaded outskirts, has long furnished a certain type of hotel with an excuse for front page advertising. In the tenement districts roofs are made to serve as laundry yards, which purpose they generally serve but poorly owing to the fact that they are seldom high enough above their neighboring tenements to escape the smoke from innumerable flues. Here, too, on hot summer nights, they become breathing spaces for the tenants, although little effort is expended to make them suitable for this purpose, the owner considering that he has done his part when he has provided a stairway and a parapet to prevent children from falling off into the alley.

It is safe to assume that not more than 5 per cent of the available roof area of our cities is serving any purpose. Available space is, of course, understood to mean that part of the total roof area which remains after deducting the usual elevator and stair penthouses, flues, and skylights.

The problem becomes resolved then into two questions: Is it practical from a financial standpoint to attempt to make use of the roof to a larger extent than at present; and, secondly, if it is practical, to what uses can the roof be put?

The returns yielded by an office or loft building depend upon its percentage of rentable area. The primary consideration in the planning of buildings of these types is to obtain the greatest possible amount of rentable space out of a given cubage. When the roof becomes rentable, the value of the building is increased, provided the cost of developing the roof is not excessive.

As for the question of expense, it is one which cannot be answered in general. It depends entirely upon the nature of the business for which the roof is to be rented and the requirements of the particular problem. It is probable, however, that the expense would usually be no greater than the cost of finishing off a like area on a typical office floor, and perhaps much less.

The first step, then, is to consider to what purposes roof room is particularly adapted — in short, what industries require light and air in abundance.

Perhaps the first suggestion is agriculture and its allied industry, horticulture — a somewhat startling suggestion, to be sure. Market gardening in the skyscraper belt is not the rule at present, and our conception of horticulture in the closely congested parts of the city is likely to include little more than an occasional window box and the aforesaid artificial grapevines. But is it difficult to imagine greenhouses over our offices? After all, a greenhouse isn't much more than an overgrown penthouse with skylights, light in construction, so that the additional load on the roof girders is not prohibitive. In fact, this single item of extra roof framing is the only thing that raises the cost of the greenhouse on the roof over the cost of the same building erected in the country; while the fact that the isolated greenhouse has its own foundation for which excavation must be made scores a point in favor of the roof house. Moreover, the greenhouse in the country must have its own heating plant, its own lighting and plumbing facilities. On the roof it takes its heat and its light and its water from the systems which supply the entire building.

Greenhouses covering 5,000 or 6,000 square feet are quite within the range of possibility on many of our larger buildings; while department stores, which as a rule have larger unbroken roof spaces than office buildings owing to the fact that they are less likely to be of the U-type plan, might easily afford several times as much area.

The standard width for greenhouses is 40 feet, although smaller ones are frequently used and could be adapted for small buildings or U-type buildings with narrow wings. The 40-foot house could be placed without difficulty on broad, unbroken roof areas — warehouses and department

stores, for example. Office buildings of the U type whose typical floors form their wings of two 20-foot offices with a 5-foot corridor, would accordingly permit the erection of a standard size greenhouse on each wing with sufficient space on all sides for circulation between the house and the parapet.

It is probable that these greenhouses would be more in demand by florists, whose source of supply would thus be placed close to their city showrooms, than by the markets whose produce generally comes from wholesalers; but it is equally probable that many markets, particularly the higher priced shops of the so-called exclusive variety, could use them with profit for the raising of winter vegetables. Winter strawberries must be raised under glass, and they bring high prices eight or nine months of the year.

The greatest difficulty in the adaptation of roof greenhouses to market gardening lies in the necessity for frequent renewals of soil and in the depth of soil required for most vegetables and in the need for much natural fertilizer. The amount of fresh, moist dressing which would have to be carried to the roof on the freight elevators would not only necessitate large storage facilities on the roof, but it would be likely to fill that part of the building near the elevators with objectionable odors whenever the dressing was being carried to or from the roof. Then, too, the labor of supplying a sufficient quantity of dressing for a greenhouse large enough to be worth while would deter most gardeners from making the experiment. Nevertheless, there are fruits and vegetables, such as strawberries, which require comparatively little soil and dressing or which can be fed with artificial fertilizers; these could well be raised in roof greenhouses with little inconvenience and supplied to markets with the saving of freight charges and careful packing — an important consideration when they must be brought in from a distance.

On the whole it is probable that the roof greenhouse would appeal more generally to florists. Hothouse flowers as a rule require little natural dressing. Artificial fertilizers or dried dressings, such as sheep dressing, which may be obtained in a condensed form, dry and odorless, are commonly used. These could be taken to the roof without difficulty and easily stored in convenient quantities. The variety of plants adaptable to such greenhouses is also much larger than in market gardening. An expert with whom the writer discussed the question expressed his enthusiasm over the suggestion, remarking that roof greenhouses for the cultivation of carnations alone for city stores would be worth while. The problem of transporting sensitive plants and cut flowers from suburban sources of supply to city salesrooms becomes serious in cold weather. Many a consignment of flowers has been ruined by frost during shipment because insufficiently protected. A greenhouse on the roof of a commercial building, supplying flowers to a florist's shop on the street floor of the same building, would eliminate entirely this important item, besides placing the entire supply within reach of the salesmen.

That the suggestion is practical, has already been proven in several instances. One of the New York department stores maintains an extensive range on its roof, where a considerable variety of plants are raised, and elsewhere florists are making similar experiments. So far, however, the practice has not become common, perhaps for the simple reason that most of us haven't thought of it, or perhaps because, the idea being new, the average city florist has preferred to wait for somebody else to try it first.

If it may be admitted that there exists an adverse side to the question, it is only fair to add that the adaptation of roof greenhouses to the cultivation of flowering plants in large quantities has not yet been without difficulties, at least on very high buildings. For some reason, many plants do not bloom well under these conditions, and patient study and experimenting will be necessary before the exact cause for this lack of complete success is found and corrected. With foliage plants, however, no such difficulty is encountered, and their cultivation at any altitude likely to be reached is thoroughly practical. Thus it may be found that the particular use of the roof greenhouse will depend somewhat upon the height of the building upon which it is placed.

Most large hotels require great quantities of flowers, cut and potted, ferns and palms, particularly the latter, for decorations. Frequently their decorators find it necessary to carry many team loads of supplies to the hotels for an evening's entertainment, remove them the following morning, and perhaps return with them a day or two later. This, in extreme winter weather, means much labor and careful protection against freezing. The advantage of a single glass roofed storage house on the roof of the hotel is obvious. It is quite probable that florists who hold contracts with the hotels for extensive decorating would find it economy to maintain such a greenhouse if granted the privilege, particularly if given the additional privilege of keeping a stand in the hotel lobby for the sale of cut flowers. In fact, several of the

large hotels have roof conservatories where much of their decorative material is raised and stored.

From greenhouse to open air gardens is but a short step, but the open garden presents difficulties that the greenhouse does not, and it is unlikely that it will appeal quite so readily to the prospective lessee. Yet it is by no means an impossibility, and with the problems of a sufficient supply of soil and of adequate drainage satisfactorily worked out it might be made practical. On buildings of great height climatic conditions would have to be considered, for conditions only 100 or 200 feet above ground are not the same as at earth level. Hail storms at an altitude of 300 or 400 feet might do far more damage than at street grade. Wind breaks would have to be provided. On the other hand, there would in all probability be much less harm done by insects and birds.

Of the two schemes the greenhouse is the more practical, but agricultural and floricultural experts admit that neither greenhouse nor open garden on the roof is to be dismissed as an absurdity.

Consider for a moment the studio. A generation or two ago when a photographer set up his shop he needed little more in the way of stage props than a claw footed armchair and a hazy back drop of woolly clouds and trees and a Renaissance gatepost. An artificial palm was the limit of his requirements. We all still cherish, somewhere in our possessions, the old family album, leather bound, with brass corners, wherein rests the photograph of Uncle John and Aunt Emma, taken on their honeymoon in the late seventies. John, stiff and solemn, sits erect in the claw footed chair, one hand clutching his hat while the other grips the arm of the chair. At his side stands his meek little bride, one hand resting on her master's shoulder. To-day we are more exclusive in our tastes. We do not care to be photographed against the same background that has served for a thousand other sitters — we want something different. For a time the stock casement window did very well until every movie actress from Mary Pickford down had been pictured with an I-see-him-coming expression on her million-dollar face. Then leaded glass went out of favor and the Queen Louise staircase came and went. Now, when it is possible, we summon the camera man to our homes; when it is not possible we put it up to him to provide a background that will not be recognized at first glance by our friends.

Here again the roof offers its advantages. A roof studio provides the widest range of possibilities in lighting; it also gives innumerable opportunities for out-of-door settings. The old-fashioned garden, the Colonial doorway, the garden gate—the list may be prolonged *ad infinitum*. The lady who goes in for æsthetic dancing may pose *a la Psyche* without the bother and expense of taking the artist into the country in search of a real pool.

The painter likewise may find in the roof studio advantages that the ordinary indoor rooms cannot possess. The typical office in the modern office building does not afford very satisfactory lighting facilities as a rule, from the artist's standpoint — not the sort of lighting, at any rate, that one expects in carefully designed studios. Overhead lighting, so essential to exhibition rooms of any considerable size, is not generally to be found in office buildings. Perhaps this accounts in part for the fact that the art centers of our cities are frequently located among the old buildings of second class construction, whose upper stories are easily converted into studios by the addition of skylights, either of hipped or sawtooth form, which can be readily cut into old wooden roofs, but not so easily added to the newer buildings of steel and concrete construction. Experience is showing that studios erected upon the roofs of high buildings and taking the form of bungalows, cabins, deck houses — whatever you wish to call them — come about as close as possible to the ideal studio in the crowded sections of a city. For the art schools such quarters may be particularly well adapted. There are limits, of course, to the landscape possibilities; but the art school which can offer outdoor class rooms in the heart of the city has an attraction which few can offer at present.

Many city schools, located in districts so congested that proper playgrounds are impossible, have used their flat roofs with success. The chief consideration seems to be a high fence of stout wire netting above the parapet to protect the heads of passersby in the streets from flying missiles. Outdoor class rooms which not long ago were thought to be desirable only in children's hospitals and similar institutions, are now becoming more and more in demand. In the country or suburbs the problem is simple. In the center of the city, particularly in the over-inhabited slum districts, the only available location is the roof. In fact, so far as the city school is to be considered, there is little excuse for not utilizing every available square foot of flat roof, either for playgrounds, for open-air class rooms, or for the little flower and vegetable gardens that the primary school pupils are taught to cultivate.

Large department stores often maintain a chil-

dren's department where mothers may leave their youngsters in the care of nurses while they are busy with their shopping, but comparatively few stores have used their roofs for this purpose. Even vaudeville houses and moving picture theaters have provided rooms where children may be checked for the duration of the performance, quite as one might check an umbrella, but the rooms are generally artificially lighted and artificially ventilated, often in the basement, and far from desirable. Again the question. Why not go to the roof? It might necessitate elevator service, but many theaters are installing elevator service anyway. All this in recognition of the fact that the custom of children exists. There are those of us who are still old fashioned enough to object to checking the baby. We shudder to think what might happen if we lost the brass tag.

While we are still on the general subject of playrooms and playgrounds, let us consider for a moment the possibility of roof playgrounds for grown ups as well as for children. Given a roof of a fairly good sized office building, add a couple of locker rooms and toilets and a shelter, lay out as many tennis courts as the space allows, all of which adds but little expense, and you have a source of income which will last from early spring until the snow flies. There can be no doubt that a public tennis court, so located, would draw all the patronage it could accommodate when its existence once became known. That a mid-week double header in the American League can draw twenty or thirty thousand men from their desks is sufficient evidence that any attractive sporting proposition will bring out its followers any day in the week, whether school keeps or not. Outdoor skating rinks are also among the possibilities of the roof, although incurring greater initial expense.

Places of amusement of various sorts have long been erected on roofs, particularly on the roofs of hotels. It is hardly worth while to go into detail on this subject. Cafés and restaurants, cabarets, open air dance halls, and summer theaters have all been found successful. Here again adequate elevator service must be provided, for the greater part of the theater's patronage must be carried to and from the street in a short space of time, before and after performances, except of course in the case of continuous performance houses, where the audience is constantly changing. The New Theater, New York, which unfortunately failed to realize the dreams of its founders, and which later became the Century, made use of nearly the whole of its great roof by erecting here a smaller theater, directly over the main auditorium, where plays for children were given, besides providing a tea room, with its service rooms, and a promenade or open foyer to be used in conjunction with the larger theater. A palm garden, glass covered, was made available for use throughout all seasons of the year, with restaurant service. Other theaters and opera houses have made use of the corresponding space for rehearsal rooms and dramatic schools.

Stores, manufacturing concerns, and large offices might well place their employees' rest rooms on the roof with double advantage. The location offers far greater attractiveness than inside rooms, while the space which would otherwise be used would thus be freed for commercial use.

Wireless stations are common on the roofs of stores and offices which find it worth while to maintain their own service, although at present private plants are either dismantled for the duration of the war or have been taken over for the exclusive use of the government. Incidentally, mention of the war brings out the fact that many a rifle club and home guard company, born of the preparedness movement, has found its most convenient parade ground on the roof.

Many a club of considerable size and pretension, with quarters on the upper floors of an office building, has apparently overlooked the chance the roof over its head offers for development.

Even living quarters are well worth considering. Placed high above the streets, they prove far more pleasant and quiet than the average tenement. A Chicago architect has recently built for his own use a $40,000 bungalow on the roof of an eight-story apartment house. Without commenting upon the rarity of architects who can build themselves $40,000 residences, it may be mentioned that the house has proven extremely pleasant. Sufficient space surrounds the building for generous promenades and verandas, a wide view across the city and lake is afforded, the air is cooler and clearer than at street level, and the absence of insects at the roof grade has made screens unnecessary. A similar residence on a twenty-one story building in New York is the home of a prominent actor who also is enthusiastic over his lofty roof dwelling. Altogether the experiment has been found so successful that it is quite probable that it will be widely copied, although one is inclined to imagine that the owner might find himself at a disadvantage if his hat should blow off.

When once architects commence to consider the flat roof as a great undeveloped possibility, the wonder will be not what can be done with it, but why it has been so neglected heretofore.

Details of Italian Renaissance Architecture

MEASURED DRAWINGS BY MAURICE P. MEADE

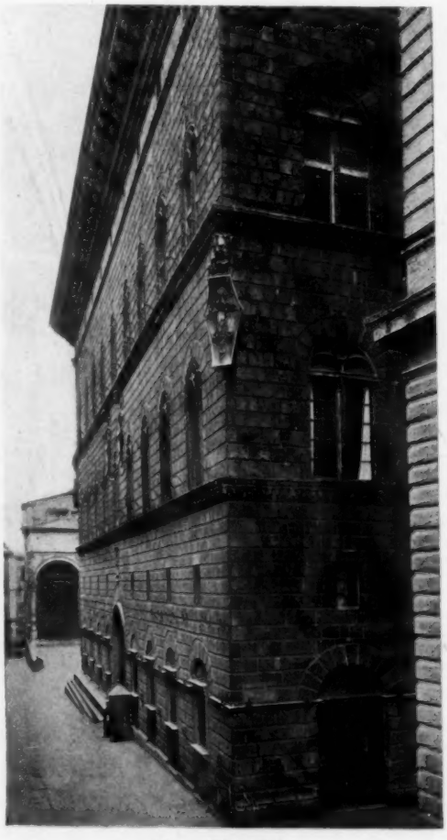
IN the presentation of details from the work of Italian designers of the Renaissance, little has been shown of the examples existing in Siena. The accompanying plates of this series, however, are of details found in that city, scarcely half a hundred miles south of Florence — the birthplace of the Revival. Together with all the dignity and reserve of the Renaissance, a slight deviation of the style is to be noted in some of the structures of brick that is peculiar to the region.

In the drawings of the first plate is shown the doorway of a house in Siena with a simple architrave, devoid of ornament, framing a finely proportioned door. The façade of this unpretentious house is of the characteristic brick and stone trim treatment. There is a pleasing simplicity to the stone mouldings in contrast to the woodwork of the doors with their deep panels and delicate bosses.

In the second plate is depicted the main entrance door of the Palazzo Piccolomini, now the Palazzo Governo, erected about 1469 for Nannie Piccolomini, father of Pope Pius III. There is a slight resemblance to the Palazzo Riccardi in the general conception of the façade, but with a lighter and more uniform treatment of the rustication and the appearance of greater height.

On the front wall in bold relief are carved shields bearing the arms and crests of the Popes Pius II and Pius III — both members of the Piccolomini family. The grand doorway centrally placed on this façade is a fine example of an arched opening, the architrave consisting of a wide facia and splay member surrounded by a bold outer moulding — the base mould of the building. Just above the voussoirs composing this larger arch is a delicately cut bas-relief of the family seal.

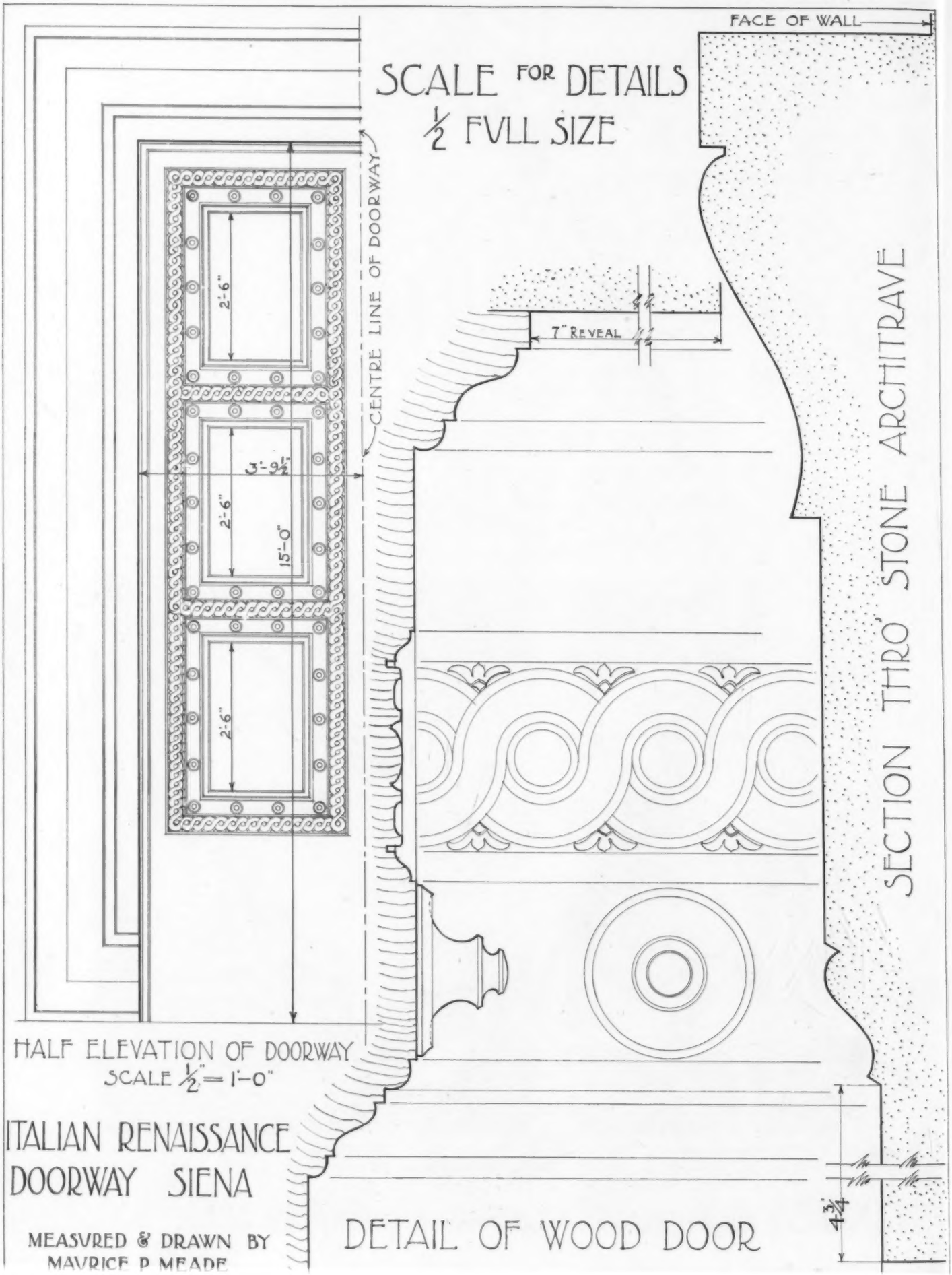
The third plate includes general details of interest on the building, such as the rustications, base moulding, stone seat, and the windows behind grilles in the plain ashler recessed arches.

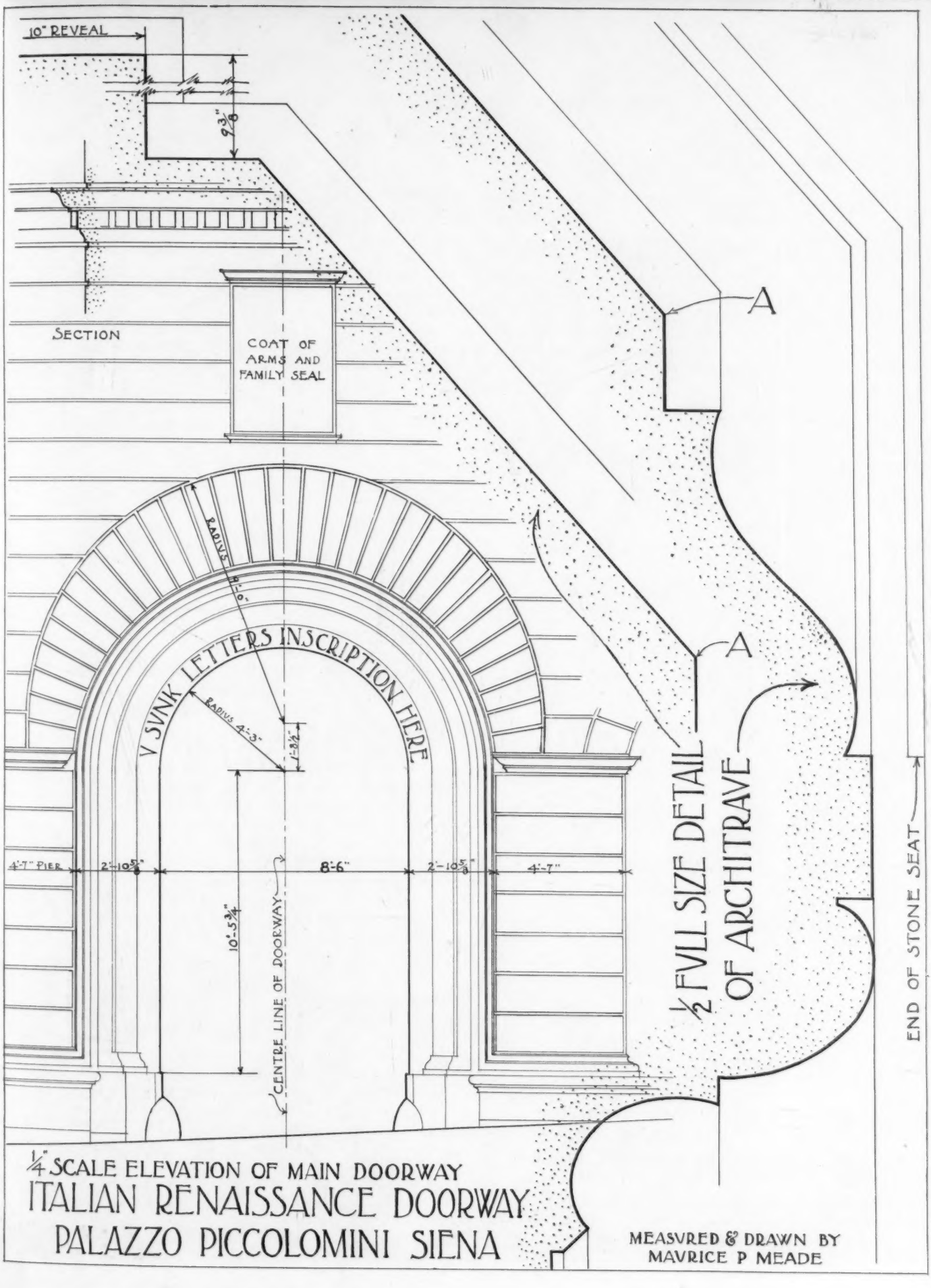


View of Main Facade

Detail of Second Story Windows

Palazzo Piccolomini, Siena, Italy


SCALE FOR DETAILS
½ FULL SIZE
FACE OF WALL
CENTRE LINE OF DOORWAY
2'-6"
3'-9½"
2'-6"
15'-0"
2'-6"
7" REVEAL
SECTION THRO' STONE ARCHITRAVE
HALF ELEVATION OF DOORWAY
SCALE ½" = 1'-0"
ITALIAN RENAISSANCE
DOORWAY SIENA
MEASURED & DRAWN BY
MAURICE P MEADE
DETAIL OF WOOD DOOR
4¾"



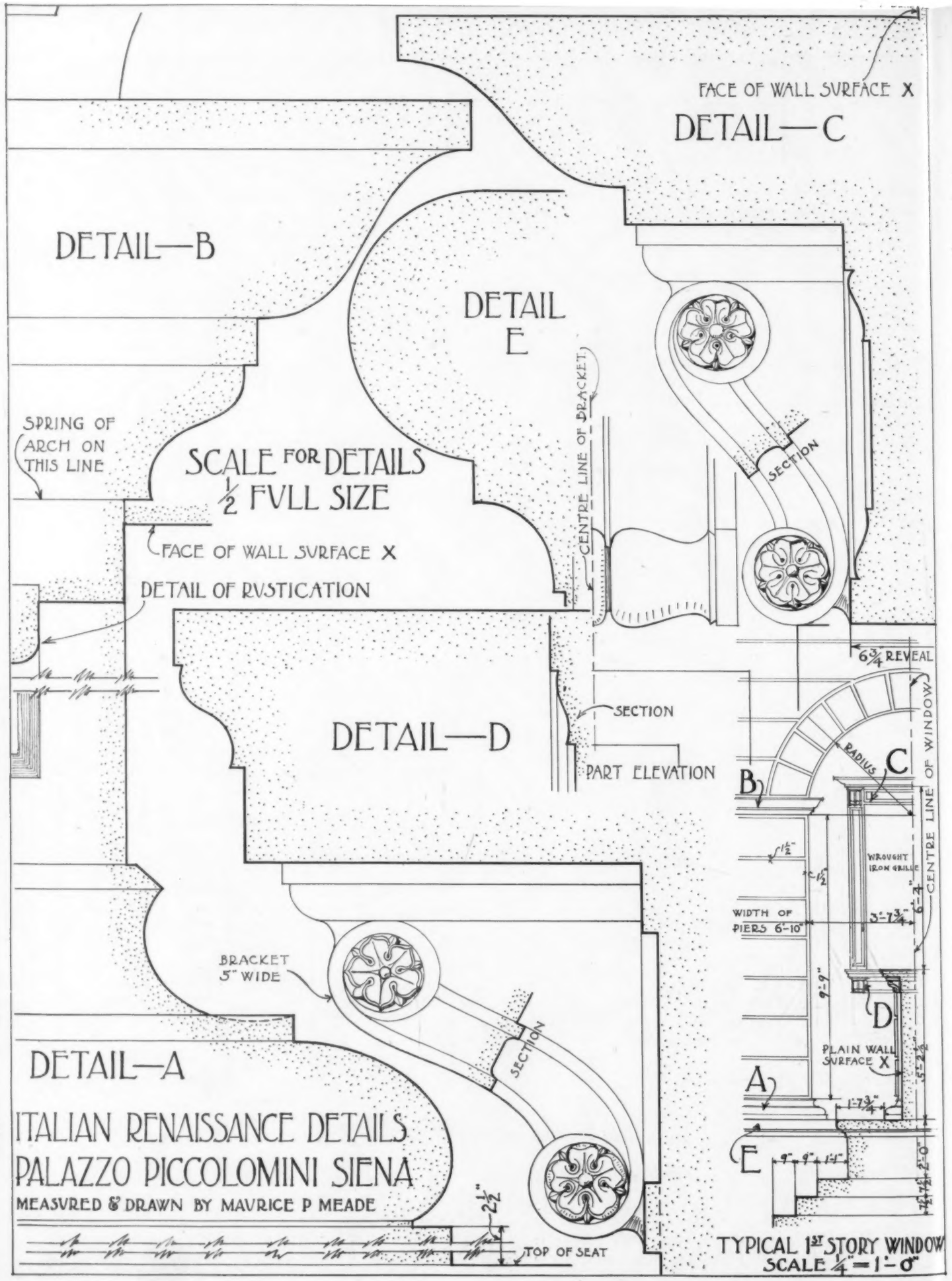
¼" SCALE ELEVATION OF MAIN DOORWAY

ITALIAN RENAISSANCE DOORWAY
PALAZZO PICCOLOMINI SIENA

MEASVRED & DRAWN BY
MAVRICE P MEADE

MEASURED & DRAWN BY
MAURICE P MEADE

DETAIL OF WOOD DOOR



ITALIAN RENAISSANCE DETAILS
PALAZZO PICCOLOMINI SIENA
MEASURED & DRAWN BY MAURICE P MEADE

TYPICAL 1ST STORY WINDOW
SCALE ¼" = 1'-0"

PLATE DESCRIPTION

MARKET SQUARE GROUP, LAKE FOREST, ILL. PLATES 65–68. The ground occupied by this square was formerly filled with small frame shops, mostly one story high, facing the railroad station, and behind them were excessively deep back yards often filled with rubbish. In view of the conspicuous location a plan was evolved by a self appointed committee for purchasing the ground and rebuilding the area in a manner which would be a credit to the town and a profitable investment. In consequence the property was acquired and the buildings erected by the committee, acting as trustees. The money was obtained by voluntary subscriptions from the residents of the town, for which they received trustees' certificates. The land and buildings in their completed form have cost approximately $550,000, including the parking, fountain, paving, sidewalks, lighting, etc. In place of 15 or 16 old tumbled down shops, the improvement has 28 stores, 24 apartments, 12 offices, a large Y. W. C. A. occupying the entire second story of the building at the end of the square, at the rear of which is a building 50 by 94 feet entirely devoted to a men's club and gymnasium. There are still two pieces of vacant property where eventually a public library and other similar buildings will be erected. The parking and streets have been dedicated to the city as a gift, which maintains lighting, cleaning, and the fountain. About 12 per cent of the space remains to be rented, and the investment when this is accomplished will pay between 4 and 4¼ per cent. In general the style is English, though the towers suggest Munich.

ELEANOR CLUB, CHICAGO, ILL. PLATES 69, 70. The dimensions of this building are 147 feet frontage and 88 feet depth. Exterior walls are brick, and interior bearing walls, hollow tile. Partitions and furring are of clay and gypsum tile. The main floors and roof are of reinforced concrete with metal lath and plaster suspended ceilings. The roofs of the wings are of frame construction covered with variegated slate. The roof garden floor is quarry tile, basement floor cement, and all others and stairs of terrazzo. The interior finish of first floor is quarter sawed white oak ; that of sleeping portions straight sawed white oak. The toilet rooms are wainscoted with Missouri marble. Plumbing fixtures are enameled iron. The exterior walls are faced with wire cut brick and limestone. Heating is effected by a graduated control steam system with steel boilers. The building was constructed early in 1916 and cost per cubic foot 22.76 cents, including mechanical equipment.

FIRE STATION, SALEM, MASS. PLATE 72. This building is faced with water-struck brick laid in English bond, with wide rough joints, which gives the effect of antique brickwork. The exterior was designed to harmonize with the old Salem buildings, a good many of which, spared by the conflagration of 1914, are in the vicinity. The building has a slate roof and the shutters and blind work on the front elevation are painted a sage green, while the cornice, railings, etc., are white. The first floor is of reinforced concrete construction entirely waterproof. The walls of the apparatus room are of sand-lime brick with an English black enamel brick base. The second story contains nine individual bedrooms with shower baths, linen closets, etc. There is also a repair shop with provision for its future extension and the usual equipment of hose drying racks, dryers for firemen's clothes, etc. The building contains 143,235 cubic feet and cost $28,230, or about 19 cents per cubic foot.

HOUSE AT LINDEN COURT, ST. MARTINS, PA. PLATES 74–76. This house is coated with rough-cast on 13-inch brick walls, the plaster being made of clean white sand with a little screened Jersey gravel added to kill the dead white and brought to an even floated, sand finished surface. The wrought iron balcony and French window grilles are executed in a smooth, workmanlike manner with a refreshing absence of conscious "hammer marks." The column capitals at the entrance portico, with their dolphin volutes, are lovely bits of detail and beautifully carved. The roof is covered with split cypress shingles with beveled butts. The plan and the interior finish are extremely simple. All the woodwork is white and very carefully studied with a view to making its appeal on premises of line and proportion. The house is heated by a warm air system and cost a year ago 23 cents per cubic foot.

HOUSE OF FERDINAND HOWALD, ESQ., COLUMBUS, O. PLATES 77–80. This house was built in 1912–1913 and cost 40 cents per cubic foot, the total cost being about $75,000. The house and garage are of fireproof construction with exterior brick walls of rough red tapestry brick about 9 inches long and 1¾ inches thick, and laid in Flemish bond with two stretchers and a header with blind joint between stretchers. Mortar joints are one inch thick. All interior walls are of brick or terra cotta tile and floors of reinforced concrete and terra cotta tile. The roof is covered with one-half inch sea-green slates of rough texture.

EDITORIAL COMMENT

AS the figures of enlistments among the professions are tabulated, it is seen that the percentage of men in service from the architectural profession stands very high. This is a fine example of patriotism of which architects may be justly proud. There are a number of conditions which make army or navy service of particular interest to the younger architects and draftsmen if reasons other than duty to the nation are needed. The war offers a great opportunity to visit the Old World, which always holds a strong attraction for architects, and the development of modern warfare has opened so many possibilities in engineering and construction necessary to support the army in the field that the architect readily finds himself of direct and almost immediate value in the carrying on of this work. The fascination of outwitting the enemy by clever disguises for moving troops and heavy guns, through color and design, makes a strong appeal to the artistic sense of American architects and painters, just as it did to the Europeans. A full company now studying the art of camouflage in Washington was largely recruited from the ranks of architects, artists, and sculptors in New York City alone.

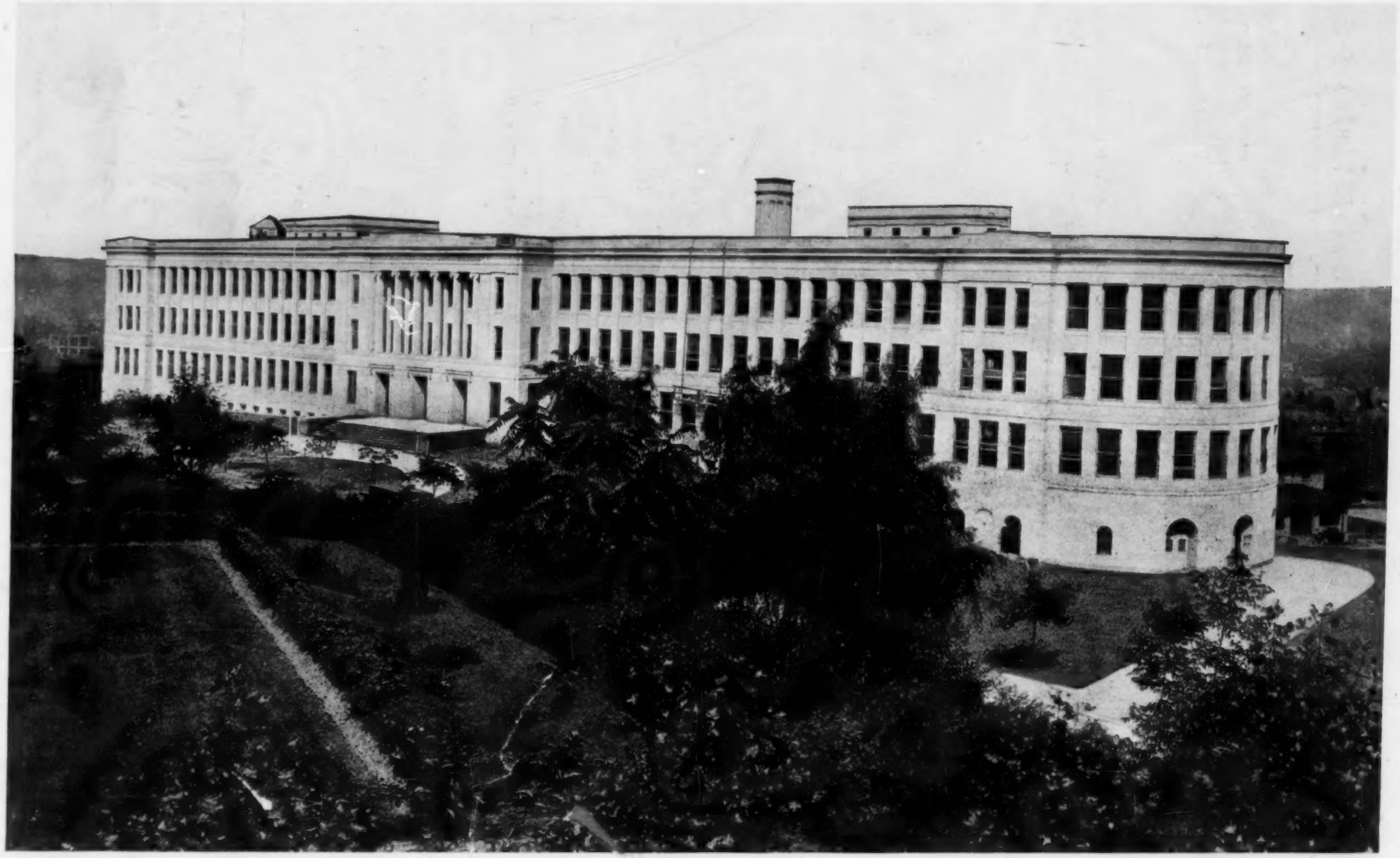
It is unquestionably our present duty to aid the Government in every way that lies in our power in its prosecution of the war, and the spirit which architects have already manifested leaves no doubt as to their very live patriotism. While nothing should at this time be given precedence over our nation's stand for world democracy, it is well for us to remember that there is a future ahead. The day of peace will come in due course and with it many new problems that will tax our ingenuity fully as much as the difficult ones we now face. There is a serious aspect to the architectural profession in the large enlistments of young men that will have its effect in the years of reconstruction to follow the war. At the present time their greatest service is unquestionably to the nation, and while some may think it fortunate there is this opportunity to take up the slack that is naturally occurring in the building world, it is a fact that at present so many have entered the service there is a noticeable lack of draftsmen to meet the needs of present necessary work. As a single instance of the number of men so engaged, the case of the Boston Architectural Club may be cited. Out of a comparatively small membership, sixty men have joined the forces. The same condition is noted among other architectural societies throughout the country. The enrolment in the architectural schools is another evidence of the presence of war. The classes show memberships of 50 per cent and more below the normal registration. In the medical profession this condition, of course, is also apparent, and due to the recognized necessity of maintaining the supply of physicians medical students have been discouraged from enlisting in the thought that their greater value lies in preparing to practise their profession. The need for architects can hardly be considered on the same plane of necessity as for doctors, but the ultimate effect in one profession will nevertheless be the same as in the other.

Furthermore, many of the men now in military service will not return to the profession — some will, if the war continues, be called upon to make the supreme sacrifice of their lives; others through their changed environment will find within themselves new resources that will lead them to other callings when they resume civil life. In any event, the outcome will be a very evident diminution in the ranks of architects, and at a time when the need for architects will probably be greater than this country has ever before experienced.

The remedy lies only in a greater cultivation of our present resources, so that what will be lost in numbers of men may be offset by a greater efficiency among those remaining to carry on the profession. After the war this country will take an enormous part in restoring the industries, property, and wealth which have been destroyed in the past three years. The demands that will be placed upon us to provide buildings that will serve our business interests and restore to a normal ratio the housing quarters of the people, will require the services of a body of architects capable of directing large enterprises with speed, efficiency, and full confidence in their abilities.

A CORRECTION

THE author and editors regret that through an error the design of the additions to the Polytechnic Elementary School at Pasadena, Cal., appearing in the article, "One-Story and Open-Air Schoolhouses in California," in our July issue, was credited to Mr. Elmer Grey. Mr. Myron Hunt was the architect of this work and credit should have been given to him.



Architect—Edward Stotz, Pittsburgh, Pa.
Contractors—Thompson-Starrett Company
New York City

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Another "NATIONAL"ized Building

"NATIONAL" Pipe in Large Buildings

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¶ Those interested in the progress of education in all its phases have flocked, from every section of the country, to see this wonderful new building (An education in itself!) in order to learn at first hand the lessons to be applied to their own schools and their buildings, either those already existing or in prospect.

¶ The knowledge and skill possessed by those responsible for the design and construction of this noble devolopment of civic pride are displayed in the completeness of every detail; all material was carefully selected, to the end that nothing inferior might detract—either in appearance or ultimate service—from the architect's high ideals. Therefore

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Complete information about "NATIONAL" Pipe may be found on pages 1339–1351, inclusive, of the 1917 edition of Sweet's Catalogue.
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THE UNION ARCADE, Pittsburgh, Pa.
American Architect, Feb. 21st, pages 60–61.
Architectural Forum, March, pages 41–42.
Buildings & Building Management, May, pages 23–24.

THE EQUITABLE BUILDING, New York, N. Y.
American Architect, March 21st, pages 19–20.
Architectural Forum, April 1st, pages 35–36.

CONTINENTAL & COMMERCIAL NATIONAL BANK BUILDING, Chicago, Ill.
American Architect, May 2nd, pages 21–22.
Architectural Forum, May, pages 45–46.
Buildings & Building Management, June, pages 23–24.

HOTEL TRAYMORE, Atlantic City, N. J.
Architectural Forum, June, pages 39–40.
Buildings & Building Management, July, pages 23–24.

JOHN WANAMAKER COMPANY BUILDING, Philadelphia, Pa.
Architectural Forum, July, pages 33–34.
Buildings & Building Management, August, pages 23–24.

DODGE BROTHERS FACTORY, Detroit, Mich.
Architectural Forum, August, pages 37–38.
Buildings & Building Management, September, pages 23–24.

MORMON TEMPLE, Salt Lake City, Utah.
Architectural Forum, September, pages 71–72.
Buildings & Building Management, October, pages 23–24.

¶To readily identify "NATIONAL" material and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each line (not of every length of seamless welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible on these smaller butt-weld sizes the name "NATIONAL" appears on the metal tag attached to each bundle of pipe).
¶When writing specifications or ordering tubular goods, always specify "NATIONAL" pipe, and identify as indicated.
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(See preceding page for illustration)